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WEEKLY 8 October 2022

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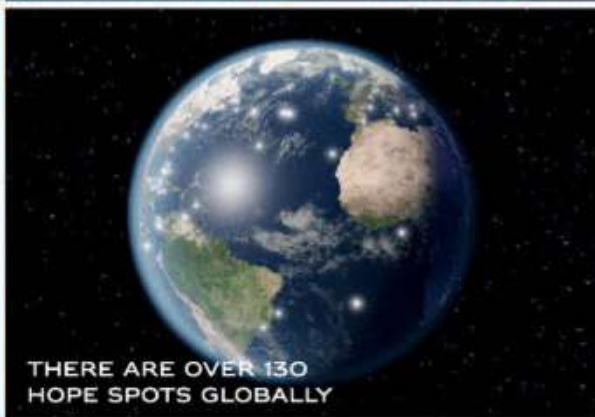
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HOPE SPOTS GLOBALLY



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THE OUTER SEYCHELLES



GREAT BARRIER REEF, AUSTRALIA



MOBULA RAYS, AZORES
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SEA LION,
GALAPAGOS,
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ON OUR WATCH

Hope can now be spotted across all our planet's seas and oceans. Sites are made into aquatic havens by local communities, to safeguard the richness and diversity of the ecosystems they depend on. Sylvia Earle's invaluable experience as an explorer and marine biologist continues to help further their goal, through her organisation, Mission Blue. Together, they have created over 130 Hope Spots and counting. Carrying a message of hope for generations to come. It is that vision, that dedication to a perpetual planet, which we are proud to stand by. For as long as it is needed.

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This week's issue

On the cover

34 Magnetic universe

The forgotten force that sculpts our cosmos

13 The next wave

Are we heading for a covid-flu twindemic?



Vol 256 No 3407

Cover image: Andy Gilmore

42 Fat vs carbs: A new way to hack your metabolism

38 Nubia finally emerges from the shadow of ancient Egypt

11 The planet that escaped our solar system

18 The first stars

31 Oliver Stone on nuclear energy

17 Who should own AI artwork?

18 Coconut sloth



Our big live show is this weekend. Friday is for schools only, but Saturday and Sunday are open to everyone. Tickets are available online and on the door at ExCeL London. Do come and join us!

newscientistlive.com

News

9 Nobel prizes

Wins for research on human evolution and quantum information

10 Ebola outbreak

Uganda struggles to control deadly virus without vaccines

14 Labour's energy plan

Can a new company help the UK's green transition?

Views

23 Comment

We must stand up for nature, says Beccy Speight

24 The columnist

Graham Lawton on the death of his beloved wife

26 Aperture

Cockatoos take off from a tree in an Australian desert

28 Letters

Vegan pets? Dogs, yes, but I wouldn't advise it for cats

32 Culture columnist

Bethan Ackerley explains why fantasy is eclipsing sci-fi

Views



30 Songs from the deep

The world of animal communication

Features

34 Our magnetic universe

The cosmos contains many beautiful structures. Did magnetism help create them?

38 Finding Nubia

We are finally beginning to understand ancient Egypt's mysterious neighbour

42 Hack your metabolism

Why a personalised approach to diet and exercise makes sense

The back pages

51 Stargazing at home

This month's meteor showers

53 Puzzles

Try our crossword, quick quiz and logic puzzle

54 Almost the last word

When moving at light speed, will a torch still shine ahead?

55 Tom Gauld for New Scientist

A cartoonist's take on the world

56 Feedback

Pop-up theatre seats and spicy water: the week in weird

GERARD SOURRY/GETTY IMAGES

Virtual event

Space, time and motion

"Where, when and how?" are some of the most fundamental questions we can ask. Join theoretical physicist Sean Carroll as he explains how the search for answers to these in cosmology led to the theory of relativity and the prediction of black holes. Watch online at 6pm BST (1pm EDT) on 20 October. Also available on demand.

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Podcast

Weekly

In this episode, the team focuses on Guatemala, where successful efforts to halt deforestation are providing some rare good news for tropical rainforests in the Americas. The panelists also discuss evidence that the risk of developing long covid is substantially lower in people who are up to date with their coronavirus vaccinations. Plus, experiments with an fMRI scanner reveal all you need to know about the brain's response to tickling.

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Podcast



SHUTTERSTOCK/K_BOONNITROD

Good news Hear about the regeneration of the Maya rainforest

Virtual event



NASA/SONOMA STATE UNIVERSITY; AURORE SIMONNET

Holes in space Discover what we have learned about the universe

Video

Diving hummingbirds

The smallest birds in the world are male, and we might now know why. Among the 30 species of diminutive bee hummingbird, males are generally smaller than females. A study suggests this allows them to perform dramatic aerial displays that impress females. The implication is that females might be driving the evolution of tiny males.

youtube.com/newscientist

Newsletter

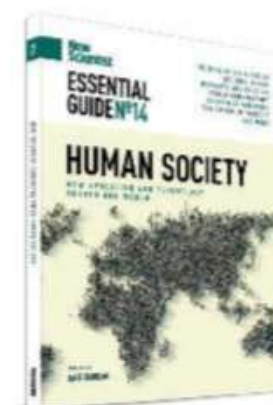
Launchpad

Astrophysicists are celebrating the planned demise of NASA's Double Asteroid Redirection Test (DART) vehicle, reports Leah Crane. The craft destroyed itself in a collision with an asteroid. We must now wait to see whether this impact altered the asteroid's orbit – a test to gauge if we could redirect Earth-bound asteroids.

newscientist.com/launchpad

Newsletter

"We can do what the dinosaurs couldn't and protect ourselves from rocks from space"



Essential guide

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Give your metabolism a break

Our appetite for eating between meals is dangerous – it is time to ditch the snacks

THE Romans ate one main meal a day, it is said, and any more would have been considered gluttony. They wouldn't think much, then, of our modern propensity for snacking. And they would be right. As we collectively fill our shopping baskets with morsels to keep us going between meals, even the most health-conscious among us could be munching our way to an early grave.

The idea that snacking can be healthy is heavily promoted by an industry that packages and brands snack products as a good way to fuel your day. Marketed as high in protein, or containing only fruit, for example, the idea is that eating small amounts more regularly can improve energy and prevent over-eating at mealtimes. Even governments and health

bodies advise on the best way to snack.

That may all seem logical, and, yes, there are times when we might all need extra energy. But the latest research reveals a hidden problem with this apparently healthy habit and, according to Tim Spector at King's College London,

“Even the healthiest of snacks can cause dangerous spikes in blood sugar levels”

our tendency for snacking is downright dangerous. There are several reasons why.

The first is a growing understanding of the importance of giving your body regular breaks from digestion – in particular from dealing with sugars, including carbohydrates – so that it

can burn through the stores available. As we report on page 42, failing to do so can leave you at risk of metabolic problems.

Secondly, Spector's own work has revealed that even those who, by all measures, are healthy and eat well can be susceptible to dangerously high blood sugar spikes as a result of even the healthiest of snacks. Eating the same food with a meal is a better approach.

Finally, constant grazing can cause an unhealthy uptick in the body's immune response, causing inflammation that we know is implicated in all manner of health problems. The science is still young, but the evidence is compelling. So next time you are tempted by a mid-morning pick-me-up, channel your inner Roman. Your metabolism will thank you. ■

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Energy nightmare
Squeeze on Russian
gas supply hits
Germany hard **p8**

Sex ratio skew
Fewer boys born
amid covid-19
pandemic **p12**

Open metaverse
Sci-fi author
enters race to build
virtual worlds **p15**

Alzheimer's drug
Trial reports
promising results for
new treatment **p16**

Dark matter
Elusive particles
may be trapped in
Earth's crust **p17**



TANNEN MAURY/EPA-EFE/SHUTTERSTOCK

The aftermath of Hurricane Ian in Fort Myers, Florida

the existing infrastructure,” said Florida governor Ron DeSantis in an update on 1 October. “Now, that will be fixed – it’s just not something that gets fixed in 24 or 48 hours.”

First responders from the Federal Emergency Management Agency (FEMA) are conducting door-to-door searches for residents that need to be evacuated. FEMA said on 30 September that it had delivered 1.1 million meals and 1.6 million litres of water to Floridians struggling in the storm’s wake.

Five hospitals in Florida were affected by loss of power and water, and more than 1200 patients had to be evacuated. At HCA Florida Fawcett Hospital in Port Charlotte, the storm tore off part of the roof of the intensive care unit and flooded the lower level emergency room.

Climate researchers warn that southern US states could see more intense hurricanes like Ian in the future, as warmer surface temperatures result in more evaporation and warmer air can hold more water vapour, which fuels tropical cyclones. While scientists are still debating if climate change is making extreme weather events more likely, most agree it is making hurricanes more intense.

“There’s an overwhelming consensus that storms will get stronger, and they will also become wetter,” says Karthik Balaguru at Pacific Northwest National Laboratory in Washington.

It is difficult to say exactly how climate change contributed to the recent storm, says Balaguru, but Hurricane Ian may be an ominous warning of wetter, more destructive hurricane seasons to come. ■

Extreme weather

Hurricane Ian strikes

The tropical storm has torn through Cuba, Florida and the Carolinas and caused at least 100 deaths, reports **Corryn Wetzel**

MILLIONS of people in the south-eastern US and Cuba have been left without power and thousands have been stranded by high water and damaged roads in the wake of Hurricane Ian.

The storm ripped homes off their foundations and transformed streets into waist-deep canals.

“We’re just beginning to see the scale of that destruction. It’s likely to rank among the worst... in the nation’s history,” said US president Joe Biden in a press briefing on 30 September. “It’s going to take months, years to rebuild.”

The tropical cyclone first struck Cuba on 27 September, causing an island-wide blackout, before reaching Florida later on the same day.

The category 4 hurricane blasted the state with 250-kilometre-per-hour winds and more than 40 centimetres of rainfall in 24 hours in some areas. The worst damage is concentrated in Lee County, which includes the cities of Fort Myers, Cape Coral, Bonita Springs and Sanibel Island.

Hurricane Ian then crossed over Florida into the Atlantic and made a further landfall on the coast of South Carolina as a weaker category 1 hurricane on 30 September, where it toppled at least four piers along the state’s northern coast.

As of 3 October, at least 100 people have been killed, most in Florida, with four in North Carolina and three in Cuba.

Officials expect the death toll to rise as search teams comb through the wreckage, and as residents remain cut off from basic needs like clean drinking water, electricity and medical care.

Around 600,000 homes and businesses in Florida were without power as of 3 October. Residents in much of the south-western part of the state have been advised to boil water to kill pathogens, and others have no running water. Officials say it may be weeks or months before power is fully restored.

“The biggest challenge with power restoration is going to be in those areas that bore the brunt of the category 4 plus, almost category 5, impact where it may have uprooted some of

Analysis Energy policy

Germany faces a gas nightmare this winter A heavy reliance on Russian energy supplies has left Germany with no easy options as temperatures drop, says **Philippa Nutall**

A CHILLY autumn spell arrived in Germany last week, but despite falling temperatures, people are being urged to keep their gas heating off or turned down low. The country's energy regulator has warned that above average gas use for the time of year means Germany may be forced to introduce rationing.

Figures published by the German Federal Network Agency (BNetzA) showed gas consumption of 483 gigawatt hours (GWh) for the week beginning 19 September, above the average of 422 GWh for the same period in 2018 to 2021. Its head, Klaus Mueller, warned that "without significant reductions, including in private households, it will be difficult to avoid a gas shortage this winter". A reduction of at least 20 per cent in use would be needed to avoid shortages, according to the agency.

While gas stores in Germany have been filling up and are now

at 91.5 per cent of capacity, the agency said it "explicitly emphasises the importance of using gas economically".

Apparent attacks on the Nord Stream 1 and 2 pipelines (see story, right), which pump Russian gas to Europe, haven't affected the situation, said the agency. "No gas has been delivered through Nord Stream 1 since the beginning of September anyway, and Nord

20%

Reduction in gas consumption required to avoid shortages

Stream 2 has never been put into operation," said BNetzA.

The squeeze on Russian gas has hit Germany hard, as this source made up 65 per cent of its imports of the fuel before the war in Ukraine. The German government triggered the first "early warning" phase of its three-stage emergency energy plan soon after Russia's invasion in February.

In mid-June, following a 60 per cent reduction in gas

flows from Russia, the second "alert" stage of the plan took effect. This allows utilities to pass on high prices to customers in a bid to prevent long-term supply shortages and allows the use of more coal-fired electricity plants, despite the resulting increase in carbon emissions. That said, a consumer energy price cap has since followed.

If the third "emergency" stage were to be enacted, the state could directly intervene in the gas market to secure supply to "protected customers". Industry and regulators are still working out exactly how this would work.

Meanwhile, to try to shield consumers and firms from rising gas prices, the German government announced on 29 September that it would take on €200 billion in fresh debt to implement a gas price cap. Under the scheme, the state would set a limit for consumer gas prices and pay the difference between that cap and what gas importers pay on the world market.

The European Commission and member states will meet on 7 October to discuss if, and how, a similar cap could be introduced across the bloc. Mathias Koch, policy advisor with E3G, a climate think tank, suggests gas price caps should be kept "quite small, as there are better, more targeted ways" to help consumers struggling to pay their bills, such as direct payments. He is concerned that capping the price of gas in Germany, or anywhere else, will fail to reduce demand for gas, and any potential climate and energy security wins from reducing European dependence on Russian gas won't materialise. ■

Environment

Nord Stream pipes leak vast amount of methane

Matthew Sparkes

HUGE volumes of the potent greenhouse gas methane have leaked from the Nord Stream pipelines, which may have been damaged deliberately. One estimate says it is akin to annual methane emissions from a city as big as Paris.

Nord Stream 1 and Nord Stream 2, key pipelines for transporting natural gas from Russia to Europe under the Baltic Sea, sprang large leaks within hours of each other last week. European leaders have labelled the incidents as sabotage.

The Danish and Swedish governments – the nations closest to the leaks – issued a report to the UN claiming that explosions detected shortly before the leaks started were equivalent to the detonation of several hundred kilograms of explosives. Theories about the cause of the blasts include explosives planted outside the pipes by submarines or divers or inside by robotic inspection vehicles that travel through the pipes.

Reports from the Swedish Coast Guard on 3 October suggest Nord Stream 1 was no longer leaking, but some gas from Nord Stream 2 is still bubbling to the surface.

The Integrated Carbon Observation System (ICOS) – the European research network to track greenhouse gas concentrations – reported on 30 September that an "enormous" amount of methane had been released. It estimates this is equivalent to a year's methane emissions for a city the size of Paris or a country like Denmark.

Owner Gazprom has said one pipe of Nord Stream 2 remains intact and could be put into service.

Bill Caram at the Pipeline Safety Trust, a non-profit organisation, says the damaged pipes could also be fixed. "It's very specialised and some high-tech engineering, but they can cut out the damaged section, install a new section and do underwater welding." ■

Lichterfelde gas power plant in Berlin, Germany



FRANK HOENSCH/GETTY IMAGES

Nobel for study of evolution...

Svante Pääbo has been awarded a Nobel prize for his work on evolutionary genetics using ancient DNA, reports **Carissa Wong**

THE 2022 Nobel prize in physiology or medicine has been awarded to Svante Pääbo for his discoveries concerning human evolution and the genomes of our extinct human relatives.

In 1990, Pääbo – who founded the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany – pioneered methods to sequence ancient DNA by sequencing DNA from Neanderthal mitochondria, their cells' energy powerhouses. He achieved this using a 40,000-year-old Neanderthal bone.

DNA degrades and can become contaminated, meaning that sequencing ancient DNA was thought to be impossible.

"Pääbo finally achieved the [what was thought to be] impossible sequencing and assembly of the Neanderthal genome... and discovered a completely new hominin [the Denisovans] entirely by analysing and comparing genome sequences," said Anna Wedell, chair of the Nobel Committee for



Svante Pääbo celebrates winning the Nobel prize in physiology or medicine

Physiology or Medicine, at the announcement on 3 October.

Mitochondrial DNA carries very limited information on an individual's physiology, so Pääbo then sequenced ancient DNA packaged in the nucleus, or main control centre, of ancient cells.

Using three Neanderthal bone specimens from Vindija cave in Croatia, along with others from

Germany, Russia and Spain, Pääbo sequenced the 3 billion base pairs of the Neanderthal genome.

By comparing the Neanderthal genome with that of *Homo sapiens*, Pääbo revealed that these hominin groups diverged roughly 400,000 to 800,000 years ago and would have bred with each other in western Eurasia after some *H. sapiens* migrated out of Africa around 70,000 years ago.

As a result, up to 2 per cent of the genome in people of European or Asian descent originates from

Neanderthals, including genes that affect immune response.

In 2008, Pääbo sequenced DNA from a 40,000-year-old finger bone found in a cave in southern Siberia. By comparing this DNA with that of both Neanderthals and *H. sapiens*, he discovered a new type of hominin, the Denisovans.

Further analysis revealed that *H. sapiens* bred with Denisovans in eastern parts of Eurasia. As a result, people in Melanesia (a region in the South Pacific Ocean consisting of roughly 2000 islands, including New Guinea) and parts of South-East Asia have up to 6 per cent Denisovan DNA.

Pääbo's work also supported the discovery that one gene inherited from Denisovans helps present-day Tibetans survive at high altitudes with low oxygen.

Studying ancient DNA will reveal the genetic basis for other aspects of our physiology and aid medical advancements, said Gunilla Karlsson-Hedestam, a member of the Nobel committee, at the announcement. ■

Physics

... and for pioneers of quantum information

ALAIN ASPECT, John F. Clauser and Anton Zeilinger have been jointly awarded the 2022 Nobel prize in physics for experiments with entangled photons and their work in pioneering quantum information science.

"I'm still kind of shocked, but it's a very positive shock," said Zeilinger during a press conference.

All three winners were awarded for their fundamental contributions to quantum mechanics, which involved experiments using

entangled particles of light called photons. These showed that information could be instantly transmitted over infinite distances, known as quantum teleportation.

Each of the winners' experiments carried out a real-life test of a mathematical theorem first proposed by physicist John Bell in 1964, called Bell's theorem. This attempts to determine whether quantum mechanics is like the billiard-ball model of Newtonian mechanics, where one thing must follow another at a local scale, or particles separated by any amount of space can affect each other.

In 1972, Clauser and his colleague Stuart Freedman were

the first to test Bell's theorem, by measuring entangled photons.

Clauser and Freedman's data appeared to imply that quantum mechanics could have non-local effects. However, there were certain loopholes with this experiment, which had many differences from Bell's original idea.

In 1980, Alain Aspect at the University of Paris-Saclay, France, and his colleagues performed another test, to a much greater degree of precision and with less doubt, by measuring the polarisation (or orientation) of pairs of photons.

The team used a random switching device to decide which

photon to measure before they had reached the detectors. This ruled out the chance of an observer having an effect, as some critics had thought might occur in Clauser's experiment, and many physicists felt the measurements laid to rest the idea that quantum mechanics acted locally.

In 1989, Anton Zeilinger at the University of Vienna, Austria, and his colleagues expanded Bell's test beyond just two entangled particles to a state of three or more entangled particles called a GHZ state. This forms a key pillar for many quantum technologies, including quantum computing. ■
Alex Wilkins

Uganda struggles to contain Ebola

More than 40 cases have been confirmed so far in an outbreak linked to the Sudan variant of the virus, which has no approved treatment or vaccine, reports **Jason Arunn Murugesu**

THERE are growing fears that the latest outbreak of Ebola in Uganda could spread to neighbouring countries such as the Democratic Republic of the Congo (DRC).

Unlike the 2014 West African outbreak of Ebola and the 2018 outbreak in the DRC, this epidemic has been caused by the Sudan variant of the virus, which currently has no effective treatment or vaccine.

As of 2 October, Uganda's Ministry of Health said 43 people were known to have been infected with the virus. Nine deaths from Ebola have been confirmed in laboratory tests, and 20 further deaths are thought to have been from Ebola.

Most cases are in people aged between 20 and 29, according to the Ministry of Health. There have been 10 cases so far in children aged 9 or younger.

On 1 October, the Ministry of Health announced that a doctor had been killed by the disease – the country's second healthcare worker to die in this outbreak. Jane Aceng, Uganda's minister for health, also confirmed last week that 65 healthcare workers had been exposed to the disease and were in quarantine.

Ebola mainly spreads via contact with an infected person's bodily fluids, such as blood, faeces or vomit. Symptoms include fever, muscle pain and vomiting. Fatality rates of the Sudan variant have varied from 41 per cent to 100 per cent in previous outbreaks, according to the World Health Organization (WHO).

The virus is generally only spread by people when they are symptomatic, says Nathalie MacDermott at King's College London. This makes it easier to find infected people and their contacts and isolate them.

But one issue that health



HAIARAHN/WADDIA/PI/SHUTTERSTOCK



NICHOLAS KAJOB/ANADOLU AGENCY/GETTY

Above: Diana Atwine, permanent secretary of the Ministry of Health in Uganda, speaks at a press briefing on 20 September
Left: a worker at Mubende Regional Referral Hospital

officials in Uganda face is that many of the Ebola cases they have discovered in this outbreak appear to centre around a gold mine in Mubende in central Uganda.

"Gold mining is an industry which has a lot of transient workers and so people will just

"There is a good risk that it could spread across the border to the Democratic Republic of the Congo"

come in for a bit and then leave again and cross borders," says MacDermott. "It makes it much harder to trace people and work out what's going on.

"You also tend to find more prostitution in such areas and so obviously that increases the risk of spread," she says. "I think there's a good risk that it could

spread across the border to the Democratic Republic of [the] Congo, given that [the gold mine is] on a main road into the DRC."

Zeles Nabusaye, who heads a local health surveillance team in Uganda, says her team is preparing isolation centres in districts with suspected cases. Contact tracers have already tracked 400 potential contacts of people infected with the Sudan variant, she says. "This one has spread from one district to other districts – it will not be an outbreak that is easily controlled," she says.

The provision of personal protective equipment (PPE) for healthcare workers is also an issue. Some staff at Mubende's regional hospital in Uganda have gone on strike to protest the lack of PPE they have been provided with to treat Ebola patients.

Both Kenya and Rwanda have tightened their borders with Uganda and are using non-contact thermometers to check the temperatures of people crossing the border.

This is the first outbreak of the Sudan variant of Ebola in Uganda since 2012, according to the WHO. Other major outbreaks of the disease in Africa in recent years have been caused by the Zaire variant, which can be tackled with approved vaccines.

Vaccine trial planned

In 2020, health workers in the DRC fought an outbreak of the Zaire variant using a ring vaccination strategy, in which people with the virus, their contacts and healthcare and frontline workers were quickly vaccinated. More than 300,000 people were vaccinated through this approach.

There is no approved vaccine against the Sudan variant, but the WHO hopes to conduct a clinical trial of an experimental vaccine in Uganda this year. "We will be able to move fast and start the evaluation of the vaccines as soon as possible," said Anna Maria Henao-Restrepo, the co-chair of the WHO's research and development blueprint, at a press briefing on 22 September.

In a televised address on 28 September, Uganda's president Yoweri Museveni called for calm. "The government has got capacity to control this outbreak as we have done before," he said. "Therefore there is no need for anxiety, panic, restriction of movement or closure of public places."

Nabusaye is similarly confident in her country's ability to contain the disease. "Our surveillance system is strong and all our health facilities are on the lookout," she says. ■

Cognition

'Superagers' with sharp memories have larger neurons

Carissa Wong

"SUPERAGERS" – people aged 80 or over with exceptionally good memories – may have larger than expected neurons in a region of the brain that is critical for memory.

With age, most people experience a gradual decline in their memory, but some maintain a remarkable ability to recall past events into their 80s or older, on par with people 20 to 30 years younger.

Alongside a decline in memory, our brains naturally shrink with age, with previous studies suggesting this occurs less with superagers. Now, researchers have shown superagers may have larger neurons in their entorhinal cortex.

Tamar Gefen at Northwestern University in Illinois and her colleagues imaged brains donated by six superagers who died at an average age of 91. The six individuals previously took part in ongoing research into superagers.

These images were compared with those from seven people who died at an average age of 89 and a further six who died at an average of 49, all of whom had memories that would be considered normal.

The superagers' neurons were around 10 per cent larger than those of the people who died at a similar age with standard powers of memory. The superagers' neurons were even around 5 per cent larger than those of the people who died 40 years younger, suggesting that larger neurons contribute to an exceptional memory (*The Journal of Neuroscience*, doi.org/jfg2).

"[The study] adds to the growing evidence that superagers differ from typical adults on multiple levels of the brain," says Alexandra Touroutoglou at Harvard Medical School. "The sample size here is relatively small, but that's understandable. Superagers are a rare group, so finding a good number of them in a postmortem brain study is difficult." ■

Astronomy

Long-lost rogue planet could explain distant asteroids

Leah Crane

A ROGUE planet twice the size of Earth may have pushed asteroids into the outer reaches of the early solar system before it was ejected. This could solve the mystery of how some of the most distant objects in the Kuiper belt got there, which can't be explained by most models of solar system formation.

The Kuiper belt is a huge disc of cold rocks and ice that extends out beyond the orbit of Neptune. It contains three populations of objects: scattering objects, which typically orbit the sun relatively close to Neptune with their paths determined by its gravity; resonant objects, which follow particular orbits that are tied to Neptune's orbit and are often further from the sun; and detached objects, which follow non-resonant orbits and never come closer to the sun than Neptune.

Astronomers have long thought that the scattering objects and some of the others probably got there when the giant planets migrated to their current positions in the solar system more than 4 billion

years ago. But neither resonant objects with high perihelion – meaning they never come close to the sun – nor detached objects fit the same explanation.

"Jupiter and Saturn were very good at basically rapidly chucking everything out into the outer solar system," says Brett Gladman at the University of British Columbia in Canada. "But the efficiency of that process fails to make enough of these objects with high perihelion."

"The newly suggested planet could explain some especially large Kuiper belt objects"

Gladman and his colleagues used a set of simulations to study the possibility that another object, a primordial planet with double Earth's mass, was thrown into the outer solar system early on and pushed those distant objects onto their orbits. Their simulations began with this object already in the Kuiper belt and followed how it would affect the other bodies out there (arXiv, doi.org/jfhn).

They found that it worked perfectly, but not simply by gravitationally dragging the objects out with it. In the simulations, most of the Kuiper belt objects didn't interact directly with the planet.

"It's jiggling the orbits of everything in this area just a little bit and kicking things into and out of the resonances," says Gladman.

This object would have been unrelated to the giant planet that may reside in the outer reaches of the solar system – dubbed Planet Nine – as, if it exists, its orbit takes it far beyond the Kuiper belt. But the newly suggested planet could explain both how the high-perihelion objects got there and the existence of some especially large Kuiper belt objects on unexpectedly distant orbits.

Eventually, the simulations suggest the planet moved so far from the sun that it was no longer bound by its gravity and floated away into interstellar space, becoming a rogue planet. "When the rogue goes away, those oscillations in the orbits suddenly damp," says Kat Volk at the University of Arizona. "Anything that happens to be on a really high perihelion will get frozen into the orbit it's on. They get stranded."

Those objects stranded in orbits that are particularly distant from the sun then just stayed there, without any other huge objects to perturb them. The next step may be a more detailed model beginning with the formation of the rogue planet, says Volk. ■

The Kuiper belt is a ring of icy objects in our solar system



AHMAD SAREM/GETTY IMAGES

Coronavirus

Fewer boys born amid covid-19

The initial stress of the pandemic may have skewed the birth sex ratio in England and Wales, possibly due to uncertainties causing pregnancy losses of male fetuses, finds **Alice Klein**

THERE were fewer male babies born in England and Wales in mid 2020 than expected, possibly because the stress of the covid-19 pandemic led to more pregnancy losses of male fetuses.

Outside of the pandemic, more male babies tend to be born than female ones. Between 2012 and 2020, 1054 boys were born for every 1000 girls each year on average in England and Wales.

No one is sure why this happens. It may be because boys are more likely to die in infancy, so having more of them at the outset leads to a balanced sex ratio by the time babies reach reproductive age.

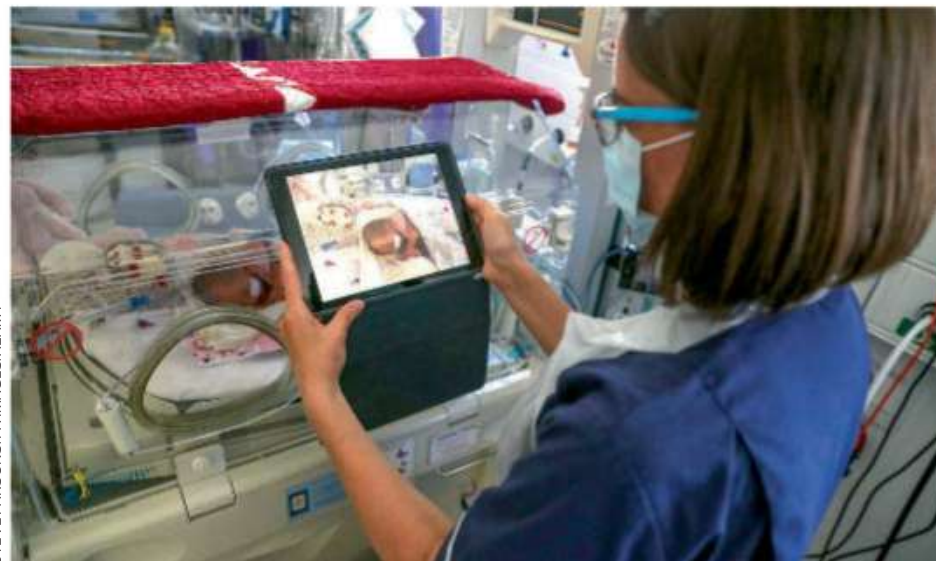
Several studies suggest there can be a sudden drop in the proportion of male births around three to five months after a stressful event that affects a whole population. This occurred in New York City after the September 11 attacks, in the UK after the death of Diana, Princess of Wales, and in Norway after the Breivik mass shooting.

To find out if covid-19 had a similar effect, Margaret Ryan at Trinity College Dublin in Ireland and her colleagues analysed birth

records spanning 2012 to 2020 for England and Wales.

In June 2020, the ratio of male to female babies born dipped suddenly, with only 1040 boys born for every 1000 girls. This was the lowest ratio of male to female babies of any June throughout the study period, with a statistical analysis suggesting this decline wasn't a chance finding ([medRxiv, doi.org/jfpgp](https://doi.org/medRxiv/jfpgp)).

A nurse films a baby amid restricted hospital visiting hours



STEVE PARSONS/PA IMAGES/ALAMY

The drop in male births occurred three months after March 2020, when the first covid-19 deaths were reported in the UK, the country went into lockdown and the World Health Organization officially characterised the outbreak as a pandemic. This suggests the initial stress of the pandemic caused a disproportionate loss of male fetuses among pregnant people in their second trimester, which may have resulted in fewer male babies being born in June 2020, according to the team.

Stressful events may activate

non-conscious evolved mechanisms in pregnant people to spontaneously abort fetuses that have less chance of thriving in tough environments, says Tim Bruckner at the University of California, Irvine. Male fetuses are more likely to be frail than female ones, meaning "their mothers may be unconsciously gauging that it's not the best environment to bring them into", he says.

This may particularly occur during a pregnant person's second trimester, assuming this is when they may unconsciously detect their fetus's health, says Bruckner.

By August 2020, the ratio of male to female births had returned to pre-pandemic levels in England and Wales, possibly because people were habituated to the pandemic and the acute stress had passed, he says.

Since the drop in male births in England and Wales was small and short-lived, it won't "distort the demographic characteristics in ways the average resident there would notice", says Ralph Catalano at the University of California, Berkeley. ■

Long covid

Vaccines could cut the risk of long covid by two-fifths

THE risk of long covid may be lower in people who catch the coronavirus after being vaccinated.

Daniel Ayoubkhani at the UK's Office for National Statistics (ONS) and his colleagues looked at a random sample of people, aged 19 to 69, who tested positive for the coronavirus between April 2020 and November 2021. The sample included 3090 people who had received a second dose of either

the Pfizer/BioNTech, Moderna or Oxford/AstraZeneca coronavirus vaccine at least two weeks before they first tested positive.

These participants were paired up with a random sample of 3090 unvaccinated people, with the individuals being matched by their age, sex, socioeconomic status, any pre-existing health conditions and whether they were white or a different ethnicity. The sample size was too small to group the participants according to more specific individual ethnicities, says co-author Vahé Nafilyan. All the participants were part

of the UK Covid-19 Infection Survey.

Long covid was defined as any symptom the participants self-reported 12 weeks after testing positive that they could only put down to the coronavirus.

Of the unvaccinated participants, 14.6 per cent reported having at least one long covid symptom, compared with 9.5 per cent of those who were vaccinated. Vaccines were linked with a 41 per cent

"Coronavirus vaccines were linked with a 41 per cent lower risk of long covid at 12 weeks post-infection"

lower risk of long covid at 12 weeks (*Open Forum Infectious Diseases*, [doi.org/jd6x](https://doi.org/10.1093/ofid/ofab666)). The longer-term risk wasn't explored.

According to Ayoubkhani, a major limitation of the study is that most of the vaccinated participants were infected when the delta variant was dominant, whereas most of the unvaccinated people probably caught the alpha variant.

"The question is now less about if vaccination reduces long-term symptoms, but why and how much, says Michael Edelstein at Bar Ilan University in Israel. ■

Jason Arunn Murugesu

Analysis Infections

Why the UK could be heading for a flu-covid 'twindemic' this winter

Last year's warnings about a bad flu season didn't materialise, but Australia's more severe outbreak doesn't bode well, says **Clare Wilson**

ALONG with several other countries, England is stepping up its efforts to persuade at-risk people, including anyone aged 50 and over, to get vaccinated against both flu and covid-19 in the coming weeks.

On 28 September, the UK Health Security Agency (UKHSA) launched an autumn vaccination campaign in England for these diseases, warning that this winter is likely to be a particularly bad one for flu.

At this point, some people may be experiencing déjà vu. There were similar claims 12 months ago, but the expected "twindemic" of flu and covid-19 didn't materialise anywhere in the UK.

However, that doesn't mean we should disbelieve the warnings this time around. Last winter, many people were still practising social distancing, to a greater or lesser extent.

In England, for example, "Plan B" rules were introduced when the omicron coronavirus variant began surging in December 2021. These included compulsory face masks in most indoor public spaces and proof of vaccination to enter venues such as nightclubs.

There was also less social mixing in other ways, for example as a result of more widespread working from home.

In the end, this couldn't hold back the omicron surge, but flu is less transmissible than the coronavirus and it was suppressed to very low levels.

The number of people hospitalised with flu in England in the winter of 2021/2022 peaked at one-sixth of the level seen in 2019/2020, before the covid-19 pandemic took hold.

"Get Vaccinated" signs in Slough, Berkshire, in the UK, in August 2022

In an average winter, 20 to 30 per cent of people are exposed to the flu virus, although many who are infected have no symptoms. This means that, for two years running, nearly all those typical exposures didn't happen. As winter approaches in the UK, there will be much less population

1 in 65

The estimated number of people with the coronavirus in England

immunity to flu than normal.

This winter, social mixing is likely to be back to pre-pandemic levels, as no plans have been announced to reintroduce restrictions in any part of the UK. The coming flu season therefore looks set to be the first in three years that will allow the usual levels of respiratory virus spread.

Australia's experience over the past few months, during its winter, provides an indicator of what may happen in the northern

hemisphere. Cases there peaked significantly higher than in the three years before the covid-19 pandemic began.

The main flu variant in Australia this year was called H3N2, which past research suggests causes more severe illness than typical seasonal flu. This strain was linked with a somewhat higher flu hospitalisation rate in the UK six years ago.

Fortunately, the flu vaccine developed for the northern hemisphere contains the H3N2 virus, in an inactivated form.

The Australian flu season this year not only saw a higher peak of cases than average, but these also happened earlier in its winter, surging in May and June rather than July and August.

For this reason, it is important that anyone in the northern hemisphere who is eligible gets vaccinated against flu as soon as they can, says the UKHSA.

"You should book in as soon as possible," Steve Russell, director

for vaccinations and screening at National Health Service England, said in a statement.

Covid-19 also hasn't gone away. The latest figures from hospitals and the Office for National Statistics (ONS) show that cases are starting to rise again in the UK.

In England, an estimated 1 in 65 people were infected with the coronavirus in the week ending 17 September, according to ONS figures. This compares with 1 in 70 people that had the virus in the week ending 14 September.

"This winter could be the first time we see the effects of the so-called twindemic, with both covid and flu in full circulation," said Russell.

"This winter could be the first time we see a 'twindemic', with covid-19 and flu in full circulation"

The good news is that the rise in covid-19 isn't being caused by a radically different coronavirus variant, but by several new subvariants of omicron – and the bivalent vaccine on offer in many countries contains an omicron component.

In the UK, everyone eligible for a booster should be offered the bivalent version, barring supply disruptions.

The twin threat makes it all the more important that eligible people take up their offers of covid-19 boosters and flu vaccines, says Simon Williams at Swansea University, UK.

"Public health campaigns need to provide clear and strong messages about the risks of flu as well as covid to those who are vulnerable as well as to the health system – akin to the 'Protect the NHS' campaign which worked so well earlier with covid," says Williams. ■

MAUREN MCLEAN/SHUTTERSTOCK



Can Labour's Great British Energy plan supercharge the UK's green transition?

Philippa Nuttall

LABOUR, the main opposition party in the UK, is promising to place renewable energy at the heart of its economic policy if it wins the next general election. Plans include the creation of a publicly owned low-carbon energy firm and significant investment in green infrastructure.

"We will set up Great British Energy in the first year of a Labour government," the party's leader, Keir Starmer, told delegates at its conference in Liverpool on 27 September. "A new company that takes advantage of opportunities in clean British power." Public ownership makes most sense for jobs, growth and "energy independence from tyrants like Putin", he said.

At the moment, many UK energy resources are owned by foreign governments and companies. For example, the largest onshore wind farm in Wales is owned by Sweden and the Chinese government has a stake in new nuclear plants, including Hinkley Point C. "Five million people in Britain pay their bills to an energy company owned by France," said Starmer, referring to EDF, which is largely owned by the French state and in the process of being fully nationalised.

But would public ownership really make a difference in helping the UK achieve its legally mandated goal of net-zero emissions by 2050?

Some industry experts have reacted positively to the announcement. Great British Energy is "exactly the kind of daring plan that will be required to accelerate the transition", says Phil MacDonald, CEO of Ember, a UK energy think tank.

Others are less convinced. Tom Haddon, a consultant at Arcadis UK, tweeted: "Why bother? Private capital is literally falling over itself to get into renewable



SHUTTERSTOCK/MARITXU

Above: Whitelee wind farm in Scotland, UK.
Below: Keir Starmer

95%
Existing UK target for proportion of clean power by 2030

100%
Labour's proposed target, for the same date

2050
Year the UK is legally mandated to hit net-zero emissions



OLI SCARFF/AFP VIA GETTY IMAGES

energy generation in the UK."

But this view reflects "a real myopia that wind and solar is all there is", says MacDonald. It is expected that these technologies, which are already well funded, will grow to make up 70 to 80 per cent of the UK's electricity generation by 2030, he says, but other, riskier technologies are needed to make up the rest of a zero-carbon electricity system.

MacDonald says these include massive investment in grid infrastructure, hydrogen, small nuclear reactors and carbon capture and storage, technologies that aren't yet mature and that have struggled to get financial backing. A publicly owned energy company could make riskier investments, which would improve the chance of such technologies becoming commercially viable, he says.

Once commercialised, these new green technologies will be in demand in the rest of the world, which is where the second part of Labour's plan comes in. On 26 September, Labour's shadow

chancellor, Rachel Reeves, set out plans for an £8 billion national wealth fund to support the development of green infrastructure, including green steel plants and battery factories, created by revenues from renewable energy. While Norway has built a massive sovereign wealth fund on the back of fossil fuels, the UK would probably be the first country to build such a fund from scratch using renewable energy assets.

Zero-carbon power

All of this means that Labour has also pledged that by 2030, the UK will generate all of its electricity without using fossil fuels.

Reaching this goal would be "a huge challenge, but we have the technologies to do it", says Sam Alvis at Green Alliance, a UK non-governmental organisation.

The previous Conservative government under Boris Johnson had already committed to 95 per cent clean power by 2030 and 100 per cent by 2035, but it is unclear whether the latest administration under new prime minister Liz Truss intends to stick to this target. Her government is lifting a ban on fracking and energy minister Jacob Rees-Mogg has called for oil and gas firms to get "every last drop" out of the North Sea, but it has also relaxed planning rules for onshore wind.

Ultimately, whether Labour can achieve a speedier green transition depends on continued action on renewables today, given that the next UK general election could still be around two years away. "If the Truss government removes barriers to renewables deployment and maximises efficiency, this goal can be met," says Ed Matthew at E3G, a UK climate think tank. ■

Astronomy

SpaceX may help extend the life of the Hubble telescope

Leah Crane

SINCE the Hubble Space Telescope arrived in orbit in 1990, it has been slowly sinking down towards Earth due to drag from the very top of the planet's atmosphere. It has had periodic boosts from astronauts aboard the Space Shuttle, but it has been steadily lowering since the craft's last visit in 2009. Now, NASA has signed an agreement with SpaceX to study the possibility of boosting it once again, which could extend its lifespan by decades.

Hubble's initial orbit was about 615 kilometres above Earth's surface and now it is less than 540 kilometres up. Without boosting the spacecraft's orbit, its demise is inevitable. By the late 2020s, NASA will have to start planning a mission to dispose of Hubble safely, probably by lowering it until it splashes down in the ocean. As of now, that is expected to happen in the late 2030s.

If SpaceX can give Hubble a boost, it could delay that. The feasibility study will involve determining whether it would be possible for SpaceX's Dragon capsule to dock with Hubble and push it into a more stable orbit around 600 kilometres up. "You'd add easily 15 to perhaps 20 years of orbit life to the mission if we could achieve that altitude," said Hubble project manager Patrick Crouse during a press conference on 29 September.

Exactly how such a mission would work is still unclear. Past missions have been crewed, but this one could be automated. It may not just be a boost, either – Space Shuttle crews performed repairs and upgrades, and this potential mission could do the same.

"At this point, everything is on the table," said SpaceX's Jessica Jensen during the press conference. "We want to benefit Hubble, and if benefiting Hubble is not just boosting it but doing some kind of servicing... all the better." ■

Analysis Virtual reality

An open metaverse Why is sci-fi author Neal Stephenson going head-to-head with Meta and Microsoft in the race to bring virtual worlds to the masses, asks Matthew Sparkes

SCIENCE fiction author Neal Stephenson predicted virtual worlds and cryptocurrencies in his 1992 novel *Snow Crash*, even coining the term "metaverse". Now, 30 years later, he is combining the ideas by launching a blockchain-powered open metaverse. The move sets him against big tech firms with their own plans, so why is he doing it and what even is an open metaverse?

Developers have pushed versions of the metaverse for decades, but the idea's time may have finally come. Last year, Facebook rebranded as Meta, with founder Mark Zuckerberg promising to spend billions of dollars to create a virtual world in which everyone can interact, and Microsoft is also investing billions in its own version of the idea.

Stephenson, however, is proposing a metaverse linked to a blockchain – the technology behind cryptocurrencies like bitcoin – so it is decentralised rather than being owned by someone. He has launched a company and blockchain called Lamina1 to act as a core for the open metaverse. It would handle interoperability between worlds,

verify the identity of users and handle financial transactions.

Neither Lamina1 nor Stephenson responded to a request for interview, but in a white paper announcing the launch, Lamina1 says the first virtual world built on its blockchain will be called "THEEE METAVERSE" and be designed by Stephenson. It promises "a richly-imagined, interactive virtual world with an unforgettable origin story".

"Many developers are still working on a metaverse that can be built and controlled by its users"

Details on what it will involve are scant, but when we talk about an open metaverse, there are two main possibilities. One is a metaverse created at least partially using open-source software, just as the open-source operating system Linux underpins many of the world's biggest technology platforms. But each created world could be a separate entity.

The other option is an ecosystem of virtual worlds underpinned by open standards that allow characters to move

seamlessly between them, just like you click from website to website in a browser, perhaps even being able to take virtual objects and digital money with you.

There are already signs that open standards can be successful in this arena. The OpenXR standard that can describe virtual environments and how people can interact with them is supported by Meta and computer chip-makers AMD and Intel. And the Metaverse Standards Forum, including members like Adobe, Meta and Google, helps settle on common standards for things like how 3D models should be represented.

Despite this, technology firms are moving towards developing their own virtual worlds, potentially so they can monetise them.

Many developers are still working on a metaverse that can be built and controlled by its users, though. An Open Metaverse Alliance has also sprung up to support the effort.

Kalila Lang, a member of the alliance and founder of software platform Vircadia, says open-source architecture is vital to the future of the metaverse, but the idea of seamless interoperability between worlds is "dumb".

Characters and worlds aren't necessarily interoperable, she says. "If I tried to take my character's guns from *Call of Duty* and then put them into *Assassin's Creed*, it'd be ridiculous. It would break the whole game."

"What we want to do is basically be the WordPress of VR," says Lang, so people can make a virtual world into any shape they want. What part the metaverse actually comes to play in our lives still remains to be seen, though. ■

This is the future of video conferencing, according to Meta



Alzheimer's drug shows promise

A new treatment reduced the severity of symptoms in a clinical trial, but the evidence revealed so far doesn't justify calling it a major breakthrough, says **Clare Wilson**

TRIAL results for a new medicine to treat Alzheimer's disease have been described as a historic breakthrough and an unequivocal win for those with the condition. Its developer, Japanese firm Eisai, has even said the results "prove" the hypothesis that the disease is caused by a build-up of a protein called amyloid in the brain.

The results certainly are promising, not to mention surprising, but it is stretching things to paint them as an unequivocal win for people with Alzheimer's disease, and the amyloid hypothesis hasn't yet been definitively proven.

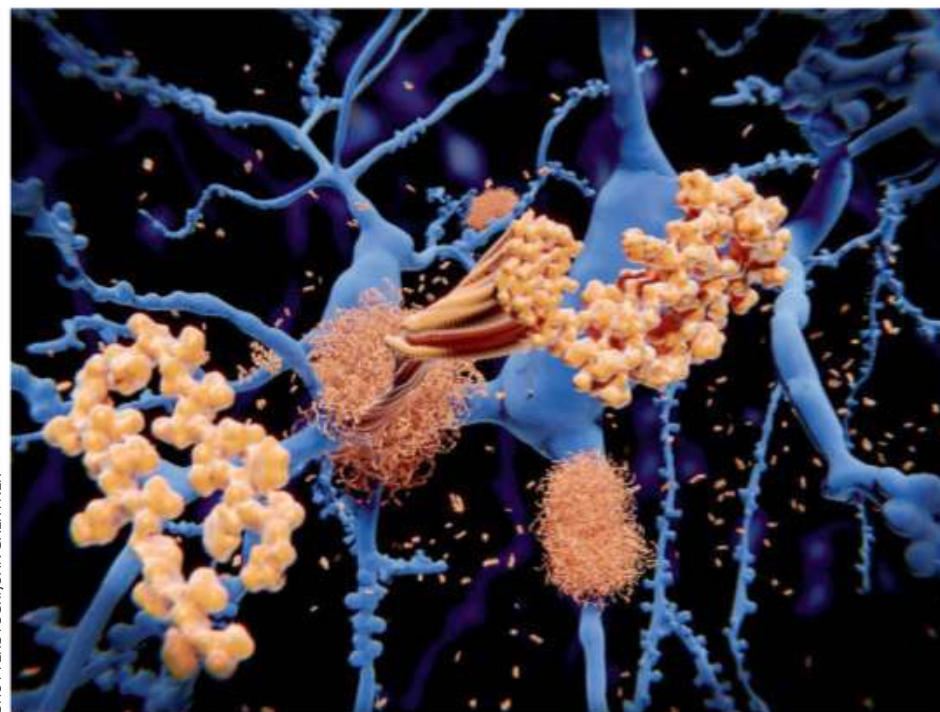
For decades, it has been widely held that Alzheimer's is caused by amyloid build-up contributing to the death of brain cells, leading to memory loss and confusion. Unfortunately, many drugs that were designed to remove amyloid haven't shown a benefit in trials.

The new drug, called lecanemab, is an antibody that binds to amyloid, leading to it being cleared from the brain by the

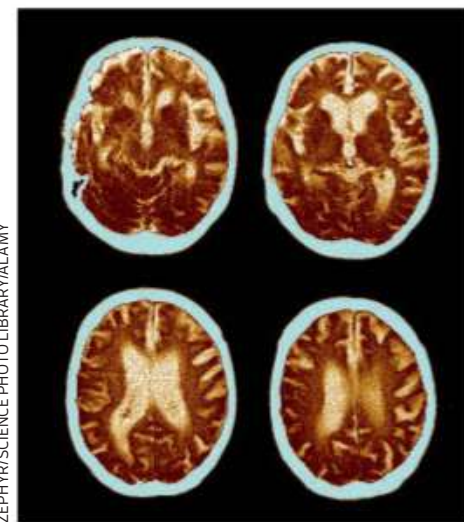
"It is stretching things to paint the results as an unequivocal win for people with Alzheimer's"

immune system. The latest study compared infusions of lecanemab given once every two weeks with a placebo treatment in nearly 1800 people with early Alzheimer's disease, in a randomised and blinded trial.

People were assessed for the severity of their symptoms using a battery of memory and other cognitive tests, as well as interviews with their caregivers and doctors. After 18 months, symptom scores for those given the real treatment had declined 27 per cent less than those in the placebo group, according to a



SHUTTERSTOCK/JUAN GAERTNER



ZEPHYRUS/SCIENCE PHOTO LIBRARY/ALAMY

An illustration of amyloid protein in the brain (left) and CT scans of a person with Alzheimer's (above)

summary of the results posted online last week.

This may sound impressive, but the difference in the scores between the two groups was small, a matter of 0.45 points on an 18-point scale. Previously, some researchers in this area have estimated that, to make a meaningful difference to people's lives, any treatment would need to improve the score by a little more than that – by 0.5 to 1.0 points, says Robert Howard at University College London, who wasn't involved in the study.

It is possible that if people received the treatment for longer, the size of the effect would increase, but this isn't certain. It is also possible that side effects from lecanemab led some people to guess they had received the real drug, which would have enhanced any placebo effect seen by them or their caregivers, says Howard.

If so, the drug would seem more effective than it really is. We can't know whether this happened until the results are published in full in a peer-reviewed journal.

Another problem is that the drug caused the potentially

serious side effects of brain swelling and small bleeds in the brain, seen on brain scans. These occurred in 21 per cent of those given lecanemab and 9 per cent of those who received the placebo.

This level was "within expectations", says Eisai. But in practice, this could mean that people taking the treatment would need periodic brain scans to check on safety.

Eisai says it plans to apply for regulatory approval for lecanemab in the US, Europe and Japan by March next year. In the UK, there would be a further hurdle: the treatment would only be offered through health services if its benefits are calculated to outweigh its costs. This is by no means certain for what could be a difference in symptoms so small that those affected and their families wouldn't even notice it.

Tellingly, the side effects of brain swelling and bleeding have also been seen with another amyloid-targeting Alzheimer's drug called aducanumab. This was approved for use in the US last year, but the decision was highly controversial, as trials had failed

to show it caused an improvement in symptoms, merely that it helped to clear amyloid.

A step forward

Aducanumab causes brain swelling and bleeding in 4 out of 10 recipients. The latest results for lecanemab suggest that these symptoms could be a typical effect of amyloid-targeting drugs.

Despite all these caveats, the latest results – if they are borne out – would indeed be a step forward for Alzheimer's research, as lecanemab is the first-ever disease-modifying Alzheimer's treatment that has a positive effect on symptoms, even if it is a very small one. It may be that, in future, a better balance of desired effects and side effects is achieved by reducing the dosage, using the drug in combination with another medicine or tweaking the mechanism, says Howard.

The results could therefore reasonably be seen as good news for those who research Alzheimer's disease – but not so much for those who are affected by the condition today. ■

Who should own the rights to AI-generated artwork?

Artificial intelligences creating images inspired by existing art is raising concerns over artists' livelihoods, finds **Matthew Sparkes**

CONCERNS over copyright have driven photography agencies to remove images created by artificial intelligence models from their databases. The worries come because AIs Hoover up vast amounts of human-generated, copyrighted art to train themselves and use this database to generate photorealistic images related to almost any text prompt. This has led to debate over who owns the copyright of an image generated by an AI.

Stock photography agencies like Getty Images and Shutterstock have announced in recent weeks that they will remove images created by AI models like DALL-E, Stable Diffusion and Midjourney.

A Getty spokesperson told *New Scientist* that "there are open questions and real concerns with respect to the copyright of outputs from these models".

Although the creators of some AI models, including OpenAI, have said that copyright of output will belong to the user who enters the prompt into the AI, smaller photo agencies are feeling the pressure to follow the example of the large companies. Dittmar Frohmann at stock agency

Photocase says his company is likely to take the same approach.

"Simply removing AI-generated images entirely from a platform is not a real solution to any of the challenges," says Ryan Abbott at the University of Surrey, UK. He says that while in theory you can legally copyright images generated by an AI in the UK, and the same should be possible in the US, it hasn't been tested in the UK and the US Copyright

An image that was generated by the Stable Diffusion AI



STABLE DIFFUSION

Office has a "policy of not allowing copyright on AI-generated art".

Neil Brown at law firm Decoded. legal says the UK's Copyright, Designs and Patents Act 1988 protects all "computer-generated" works in the country, which would probably cover AI-generated work, but there are complications. Not only could the output image be covered by copyright, but the input prompt also could, if sufficiently detailed.

Online marketplaces are already springing up that allow people to buy and sell detailed text prompts, and anyone able to prove that their text

prompt is being used by someone else could have a copyright claim.

The makers of the AIs may have terms and conditions that further muddy the waters, says Brown. "The work that you create, in my view, could be protected by copyright. But that isn't settled. So you could be in for some expensive litigation."

Frohmann says Photocase is likely to seek explicit permission from the people submitting images to the agency before allowing AI companies to use its archive for training their AIs, because these artists may object to their work being used to develop an AI that could potentially replace them. References to AI training is already being inserted into the release forms for larger companies like Getty.

Despite his stance, Frohmann says he sees AI as a tool akin to editing software and that copyright should belong to the person prompting the AI. He also currently sees no threat to anyone's livelihoods from AI art.

"If you look at the sum of it, it's a whole lot of crap," says Frohmann. "The images, if you look at them, they look good – but totally boring and predictable, and soulless." ■

Physics

Trillions of dark matter particles may lurk in Earth's crust

DARK matter can be trapped inside massive objects, and much of it may be closer to the surface of stars and planets than we realised. On Earth, there may be more than 10 trillion dark matter particles in each cubic centimetre of the planet's crust.

Dark matter is a hypothetical form of matter that isn't visible because it doesn't seem to interact with light. However, it does interact with regular, or baryonic, matter

via gravity, and particles of dark matter may occasionally smash into particles of baryonic matter.

Rebecca Leane at Stanford University in California and Juri Smirnov at the University of Liverpool in the UK calculated how these collisions would affect the distribution of dark matter inside celestial bodies. Our galaxy and most others are in huge clouds of dark matter, so a constant stream of these particles is probably entering every planet and star in the galaxy.

Leane and Smirnov found that this dark matter doesn't simply sink to the centres of planets and stars

as some past research has assumed. "If you're a dark matter particle, you have gravity pulling you towards the centre of the star or the planet, but as you head down you're bouncing off of all the matter on the way to the core," says Leane. "It turns out that even if you give the dark matter as much time as it likes, some of it still ends up near the surface because of all this bouncing."

They calculated that, in the sun,

"If there's a bunch of dark matter at the surface of the Earth, that could make it easier to detect"

this would result in 100 trillion particles of dark matter or more in each cubic centimetre of the surface.

While current detectors aren't built to search for this trapped dark matter – it is expected to move slower than dark matter hurtling in from space, so it would carry less energy and be harder to detect – a high concentration near the surface could help future experiments.

"If there's a bunch of dark matter just sitting at the surface of the Earth, that could make it easier to detect," says Leane. ■

Leah Crane

Astronomy

Quasar contains hints of one of the universe's first stars

Leah Crane



NSF'S NOIRLAB

WE MAY have found traces of the very first stars in the universe. These strange objects, called Population III stars, are expected to have exploded in massive supernovas that destroyed the stars entirely, and astronomers may have seen remnants from one of these extraordinary events.

Yuzuru Yoshii at the University of Tokyo and his colleagues found these hints while examining the light of

30 billion

The quasar's distance from Earth in light years

a quasar, an extremely bright object at the centre of a galaxy powered by matter falling into a supermassive black hole.

The quasar, called J1342+0928, is one of the most distant ever spotted at nearly 30 billion light years away from Earth. It formed less than 700 million years after the big bang.

The spectrum of the quasar's light revealed a huge amount of iron, more than 20 times as much as the sun has. The quasar also seems to have a very low

concentration of magnesium. These elements are important because they are produced in different processes, so their relative abundances can be used to determine what kind of cosmic object they originally came from.

The abundances found in this quasar couldn't be explained by standard models.

The researchers found that the most reasonable way to produce so much iron so soon after the big bang was in a pair-instability supernova: a special kind of explosion that only occurs in extraordinarily massive stars, wherein they explode completely and leave no stellar core behind, unlike other kinds of supernovae.

If such a supernova occurred close to quasar J1342+0928, debris would then have fallen towards the galaxy's centre, eventually becoming incorporated into the quasar.

The amount of magnesium produced in such a supernova is determined largely by the mass of the star that exploded (*The Astrophysical Journal*, doi.org/gqwstr).

"I was delighted and

An artist's impression of the very first stars in the universe

somewhat surprised to find that a pair-instability supernova of a star with a mass about 300 times that of the sun provides a ratio of magnesium to iron that agrees with the low value we derived for the quasar," said Yoshii in a statement.

This is the clearest signature of a pair-instability supernova yet found, he said. Because these supernovae can only occur in stars more than about 130 times as massive as the sun, this may also be evidence for the existence of Population III stars, which would have all been destroyed long ago.

These stars are crucial to our understanding of the universe, because they would have been the first to produce elements more massive than helium.

They are also often considered to be potential seeds for supermassive black holes, which are so unimaginably huge that it is hard to find a way to create them in the early universe without similarly colossal stars. ■

Animals

Newly recognised species of sloth has a head like a coconut

Jake Buehler

THE world has one more sloth species in it than we thought, a genetic analysis has shown.

Three-toed sloths are usually divided into four species. One of them – the maned sloth (*Bradypus torquatus*) – sports a thatch of coarse, brown hair, making the head resemble a husked coconut. Maned sloths occupy a strip of forest along Brazil's Atlantic coastline.

Daniel Casali at the Federal University of Minas Gerais in Brazil and his colleagues compared existing genetic data on 24 maned sloths and the physical features of 55 more to see if they were all the same species. Sloths from the southern states of Espírito Santo and Rio de Janeiro had flatter skulls, broader cheekbones and rounder jawbones than sloths from the northern state of Bahia.

Comparisons of their genes confirmed a deep evolutionary split. The researchers say the southern maned sloth is a fifth species of three-toed sloth, separated from the northern *B. torquatus* by more than 4 million years of evolution (*Journal of Mammalogy*, doi.org/jd7r). They have now given it the name *Bradypus crinitus*.

Timothy Gaudin at the University of Tennessee says that there are "almost certainly" other sloth species yet to be recognised by science too. ■

The southern maned sloth (*Bradypus crinitus*) displaying its coconut-like head



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Technology

Robotic pill could end insulin injections

A ROBOTIC pill that can propel itself through the intestine could enable injection-only drugs, such as insulin, to be delivered orally.

RoboCap, created by Shriya Srinivasan at the Massachusetts Institute of Technology and her colleagues, is 2.5 centimetres long and 1 centimetre wide. The pH in the lower intestine activates a motor powered by a small battery that enables it to move through mucus. Once it has travelled far enough, the drug is released.

The team tested its ability to deliver insulin in seven live pigs, comparing it with insulin put into the gut through a tube. They found that RoboCap increased the amount of drug absorbed by 20 to 40 per cent and lowered blood sugar compared with the control group (*Science Robotics*, doi.org/gqwsrx). **Alex Wilkins**



GETTY IMAGES/MOMENT RF/FERNANDO TRABANCO

Health

Air pollution raises risk of a stroke

LIVING in a highly polluted area may raise the risk of a stroke. Hualiang Lin at Sun Yat-sen University in China and his colleagues assessed the air pollution exposure of more than 318,000 people in the UK. The participants, aged 40 to 69 at the start of the research, had no history of a stroke. Over an average 12-year follow-up period, 5967 of them had a stroke.

After accounting for other factors, the team found that every 5 microgram per cubic metre increase in fine particulate matter, known as PM_{2.5}, that the participants were exposed to across a year was linked to a 24 per cent rise in their risk of a stroke (*Neurology*, doi.org/jd9c).

"Efforts to reduce exposures may be most beneficial to primary stroke prevention," says Lin. **Jason Arunn Murugesu**

Animals

Dogs can smell when we are stressed from our sweat

DOGS can smell the difference between stressed and relaxed humans from their sweat and breath alone. The finding could be used to inform training programmes for service dogs.

When we are stressed, our heart rate jumps, we get clammy and the cocktail of chemicals in our sweat and saliva changes.

Clara Wilson at Queen's University Belfast in the UK wanted to know if dogs could smell human stress. To find out, she and her team asked 36 people to perform a taxing mathematical exercise. "They had to count backwards from 9000 in chunks of 17 out loud in front of the research panel. And if they got anything wrong, we would

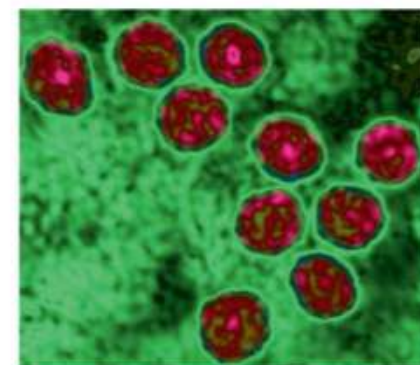
interrupt them," says Wilson.

The researchers collected sweat and breath samples on gauze before and after the exercise. They then presented four dogs trained to pick out a matching scent in a line-up with a piece of gauze from a participant taken after the task and directed them to find a match from three vials: one containing gauze from the person before the task, another from after the task and one blank piece.

The dogs correctly identified the stressed sample in 675 out of 720 tests, giving an accuracy of around 94 per cent (*PLoS One*, doi.org/gqwsr5).

Wilson hopes the discovery could inform training for service dogs that support people who have panic attacks or post-traumatic stress disorder, as the dogs are currently trained primarily on visual and body posture cues. For example, dogs could be trained to detect changes in their owner's scent, which may be present even when visual signs of stress aren't. **Corryn Wetzel**

Really brief



CAVALLINI/JAMES/BSIP/ALAMY

Zika vaccine works in mice

An experimental vaccine against the mosquito-borne Zika virus could prevent the potentially life-threatening infection from taking hold in pregnancy, according to experiments in mice. Mice given it had normal rather than underweight fetuses at full term (*Microbiology Spectrum*, doi.org/gqwsqt).

Western Arctic Ocean acidifying

Ocean acidification occurs when seawater absorbs carbon dioxide from the atmosphere, making the pH level drop. Between 1994 and 2020, pH decreased about four times faster in the western Arctic, on average, than in other oceans. The effects of this aren't yet clear (*Science*, doi.org/gqwwzs).

CART therapy for lung infections

Fungal lung infections could be treated with modified immune cells known as CAR T-cells. Two weeks after exposure to a fungus, 80 per cent of mice treated with CAR T-cells survived, but just 33 per cent of untreated mice did. Treated animals also had less fungus in their lungs (*Science Translational Medicine*, doi.org/gqwx5q).

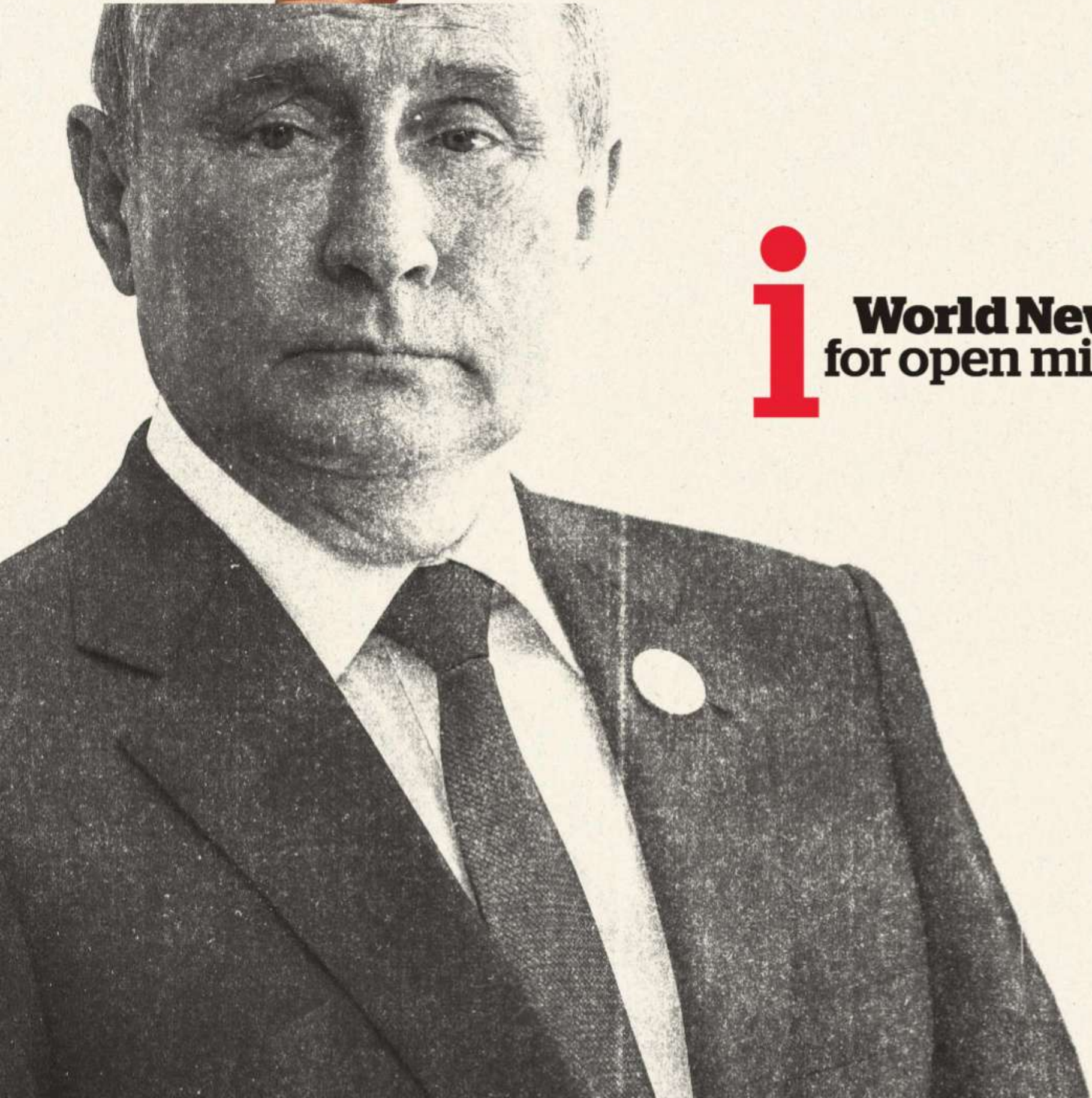
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The columnist

Graham Lawton
on the death of his
beloved wife **p24**

Aperture

Cockatoos take off
from a tree in an
Australian desert **p26**

Letters

Vegan pets? Dogs,
yes, but I wouldn't
advise it for cats **p28**

Culture

The marvellous
world of animal
communication **p30**

Culture columnist

Bethan Ackerley
explains why fantasy
is eclipsing sci-fi **p32**

Comment

Standing up for nature

The UK government's bid to slash environmental protections is an attack on nature. It cannot be allowed to succeed, says **Beccy Speight**

NATURE is in crisis. The UK is one of the most nature-depleted countries on Earth and almost half our species are in decline. The economy, our food security and our own health are all dependent on a thriving natural environment. Yet in recent weeks, we have seen the UK government launch an unprecedented attack on nature and the laws that protect it.

As part of a bid to do away with EU-derived legislation by the end of 2023, the government appears fixed on amending or scrapping crucial environmental laws. These include the habitats regulations that protect some of the most vulnerable wildlife and important green places across England.

Hundreds of other laws, including those designed to ensure clean water in our rivers and seas, are similarly under threat. News reports over the past few months highlighted the damage that sewage and pollution continue to inflict on our beaches and waterways. Now is the time to strengthen legal protections, not do away with them.

Separate plans to create at least 38 "investment zones" in England are just as concerning. The plan involves "liberalising planning frameworks to encourage rapid development" – an undefined relaxation of planning rules that I believe could constitute another massive threat to our already depleted wildlife.

A new English payments scheme that would have



SIMONE ROTELLA

supported farmers and landowners to enhance nature, create space for rare species and habitats, and use land to absorb carbon and work towards net zero is also set to be reviewed despite five years of hard work drawing it up. About 72 per cent of UK land is managed for agriculture. As a result, our ability to successfully restore nature hinges on creating a system that rewards farmers for managing land in a way that both enables the sustainable production of healthy food and supports the natural environment.

All these developments fly in

the face of the Environment Act, introduced by the previous Conservative government, which contains a welcome legal obligation to halt species decline by 2030. This policy flip-flopping also calls into question the UK's ability and desire to meet its international commitments.

We are now just two months from the start of the global Convention on Biological Diversity Conference of the Parties 15 in Montreal, Canada, where the UK will commit to a joint target for 30 per cent of the world's land and seas being looked after for nature by 2030. The UK government's

pledges and its actions now appear completely at odds.

There is precious little time left to restore nature, halt biodiversity declines and repair the damage done to the natural world. At conservation charity the RSPB we are clear, as are our partners in the conservation sector, that the time for action is now.

The roots of the RSPB are as a campaigning organisation. In the late-19th century, three women joined together to successfully end the use of birds' feathers in the enormous fashion trade. Their determination to stand up for nature against the odds is what continues to drive the RSPB today. With the UK government seemingly intent on weakening or scrapping crucial environmental protections, that campaigning spirit is needed more than ever.

Some have been surprised by the strength of our reaction to these announcements, but the scale of the threat warrants nothing less than a robust response. We are angry, and we are not alone. That anger is shared by nature lovers across the country, from all walks of life and across political divides. Millions of people up and down the UK are ready to make their voices heard and take action to protect the wildlife they love. ■

ROSIE DUTTON, RSPB



Beccy Speight is the chief executive of the RSPB. Follow her @BeccyRSPB

No planet B

A green end My late wife was an environmentalist and wanted a woodland burial. I have seen to her wishes, but eco-friendly funerals are phenomenally expensive, writes **Graham Lawton**



Graham Lawton is a staff writer at New Scientist and author of *Mustn't Grumble: The surprising science of everyday ailments*. You can follow him @grahamlawton

Graham's week

What I'm reading

A friend bought me a copy of *The Book of Form and Emptiness* by Ruth Ozeki, which she says I will find comfort in.

What I'm watching

I am oddly drawn to police procedurals about brooding detectives with unorthodox methods and a dark past. Ridley is good.

What I'm working on

Getting back to work.

This column appears monthly. Up next week: Annalee Newitz

FOLLOWERS of this column may have noticed that I have been absent for a while. I have been caring for my wife, Clare, who fell seriously ill about a year ago. She declined at frightening speed and died in August aged just 53. We were together for 30 years, married for 24 and had three sons together. My grief is immense.

She developed a rare and not-well-understood condition called nociplastic pain or central sensitisation, which is when the way the brain produces pain goes into overdrive. Even tiny amounts of "normal" pain are experienced as massive, overwhelming agony. Ditto negative emotions, tiredness and illness. Painkillers don't work, not even intravenous morphine. The condition was only recognised as a separate category of pain about a decade ago and medical science can't offer very much. Clare got sucked into a vortex of ever-escalating and never-ending pain, which led to anxiety, panic attacks, depression and drug addiction, all of which just served to ratchet up the pain even further. Once nociplastic pain has its claws in there is no easy escape. Clare couldn't see one, and she ended her own life.

I am planning her funeral as I write this. She was an environmentalist and wanted to be buried in a biodegradable coffin, preferably in woodland. It turns out that this is possible – our local cemetery in north London has a lovely woodland plot. But it is also phenomenally expensive – the coffin alone is £550. Clare had good life cover, so I have seen to her wishes. But I am sure a woodland burial is beyond the means of many people who want to donate their body to the earth.

The default option is cremation. At present, about 80 per cent of

the people who die in the UK are cremated, which is much cheaper, but extremely damaging to the environment. An 80-kilogram body contains approximately 14.4 kilograms of carbon, which is all converted to carbon dioxide when combusted. Crematoriums also use natural gas to burn the body and coffin. According to *National Geographic*, a single cremation produces 240 kilograms of CO₂, about the same as burning 100 litres of petrol.

Cremations also produce toxic pollutants, principally mercury from dental fillings. Filtration systems can prevent this from

"I am sure that a woodland burial is beyond the means of many people who want to donate their body to the earth"

venting to the atmosphere, but not all crematoriums have them.

Traditional burials are less damaging, but don't get a clean bill of environmental health either. If the body is embalmed, the formaldehyde leaches into the soil as the body decomposes. Coffins usually have metal fittings that also pollute the earth. Making coffins and headstones consumes considerable amounts of energy.

Clare's funeral won't be totally eco-friendly. Her coffin is made of water hyacinth leaves produced by a certified fair-trade grower in Bangladesh, so I guess will rack up a fair amount of coffin miles. We will travel to the cemetery in petrol-powered vehicles. But in other respects, it will be impeccably green. Her body hasn't been embalmed, the coffin is 100 per cent biodegradable and a woodland grave will quickly turn her into compost. She had

excellent teeth, so mercury pollution won't be a problem.

As well as being eye-wateringly expensive (my eyes have been doing a lot of watering lately), woodland burials are also in short supply. We are lucky our cemetery has a woodland plot; not all do.

Indeed, a shortage of burial plots of any kind is becoming a serious problem. In a 2019 article in the *Journal of the Royal Society of Medicine*, John Ashton warned that England and Wales's graveyards and cemeteries are filling up. With 100,000 burials annually, there will probably be no room in a few years.

One solution, according to Ashton, is to take inspiration from the Victorians, who responded to similar pressures on churchyards by creating large urban cemeteries, including London's so-called magnificent seven. These have served us well, but are almost full. The modern equivalent, says Ashton, is to develop green burial corridors alongside roads, railways and footpaths. I am not sure I would want my loved ones buried by a major road, but if it increases the availability and affordability of eco-burials, I am for it.

I mentioned that we had three sons together. The first of them died at a very young age and is also buried in the same cemetery. I take a little bit of comfort from the fact he is going to be reunited with his mum and that I can visit their graves at the same time.

As for other silver linings, I got a BOGOF deal on the plot and will one day have my own eco-funeral and be buried alongside Clare. Farewell my love, we will be reunited in the woods one day. ■

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Flaming galahs



Photographer Christian Spencer
Publisher teNeues

PINK-BREASTED galahs take off from a lone tree in Australia's Strzelecki desert in this dazzling spectacle captured by artist and photographer Christian Spencer. The image, which bears a striking resemblance to a map of Australia, is from Spencer's new photography book *Birds: Poetry in the Sky*, which is a collection of "fleeting moments captured in an artistic way that are gone forever", he says.

The galah (*Eolophus roseicapilla*), also known as the pink and grey cockatoo or rose-breasted cockatoo, is easily recognised by its distinctive plumage. These highly sociable birds can be found in flocks of up to 1000 individuals and are a common sight in their native Australia.

These particular galahs are taking to the sky after replenishing themselves on the water that has collected at the base of the tree. Spencer spotted them by chance while driving, and managed to get the shot after approaching them slowly, an opportunity that he says was "written in the stars". Originally intending to paint the scene, he decided to leave it as a photograph because he felt it couldn't be improved.

"It's amazing how such little things as birds can enchant us so much," he says. "The more you have an understanding of the natural history of each species, the deeper the enchantment and mystery." ■

Gege Li



Editor's pick

Vegan pets? Dogs, yes, but I wouldn't advise it for cats

24 September, p 44

From vet Mike Davies,
Gillingham, Dorset, UK

I agree that dogs can be fed vegan foods exclusively, and it is true that nutrients such as vitamin D3 and taurine, previously only available to cats from animal sources, can now be provided in other ways.

Sadly, other essential nutrients for vegan cats, like arachidonic acid derived from fungus, aren't yet licensed for animal feeding or, like preformed retinol, aren't readily available. The main vegan source of vitamin A is beta-carotene, which is suitable for dogs but not cats.

There are vegan feline products out there, and, as I lecture on the subject, I have asked where their arachidonic acid and vitamin A come from, but they don't answer. It is almost certain that cats can't be fed safely on a vegan diet right now.

We just don't dress to impress any more

24 September, p 25

From Hillary Shaw,
Newport, Shropshire, UK

I was intrigued by the statement in "Apes, not angels" that "status... unlocks every animal's ultimate goal – breeding rights", as human status signals seem in decline.

Male fashion has become more staid, dull and standardised. Men, with a few exceptions, wear almost identical sombre, dark, formal clothes rather than the flamboyant, colourful and elaborate costumes that once signalled high status. We now have much lower global fertility than then. Any possible connection?

Let's not do our worst with the moon, too

17 September, p 38

From Guy Cox, Sydney, Australia
It seems that, not content with ruining one world, we are now

intending to ruin another – the moon. In my long life, I have been a professional coral reef biologist and a professional and amateur speleologist. Both have taken me to some of Earth's most wonderful and remote places, and in each activity, the ethos has been to tread lightly and leave no trace; to take necessary specimens and nothing more. Why doesn't this apply to lunar exploration?

The moon's fossil water is a valuable record of how water came to the solar system, so of course we must take samples. But mining this finite resource to provide water and oxygen to a lunar colony is simply criminal. I hope there will be a massive rethink before this project goes too far.

From Robert Cluck,
Reston, Virginia, US

I have dreamed of a telescope installed on the moon that would point 24/7 at Earth. Perhaps such equipment could be part of the first cargo sent to the location on the moon where a base would be.

For one, its view might be a pleasant diversion for moon crews. But far more importantly, we earthlings would have the ability to constantly remind ourselves of the very, very thin film of our atmosphere, which we depend on to survive and ignore at our peril.

If it was good enough for Charles Darwin...

17 September, p 25

From Stephanie Woodcock,
Carnon Downs, Cornwall, UK
Mark Harper invites us to get the health benefits of swimming in cool, wild waters. Many well-known members of Victorian society flocked to the spa town of Malvern in England to consult

doctors, who prescribed cold-water immersion of one type or another. Charles Darwin had such belief in his own cold-water treatment that he took his beloved daughter Annie to Malvern for the same procedures when she was unwell.

Now, we are finding that Darwin was probably right about cold water being of benefit to himself. His ailments today would almost certainly be tied to the subtle inflammation that is being found to underlie many unexplained illnesses. Is the work of Chill UK, and renewed enthusiasm for outdoor swimming, today's Victorian cold-water treatment?

We must find nature's remedies before they go

24 September, p 15

From Geoff Harding,
Sydney, Australia

The antimicrobial drug derived from the sap of the Australian rainforest blushwood tree is an interesting example of the medicinal possibilities of natural compounds derived from flora.

Tropical rainforests contain a great diversity of plant species. Considering many forests are under threat, every attempt should be made to investigate these species as soon as possible. Indigenous populations, having inhabited and used the forests for food and medicine for millennia, may be aware of useful plants.

I wish I could share optimism for the future

10 September, p 27

From Don Martin,
Toronto, Ontario, Canada
It brings me joy to encounter the optimism of youth. The only statement that I disagree with in William MacAskill's article about

ensuring a better world for coming generations, is that "a dystopian future is far from inevitable".

My view comes after a lifetime of fighting for the exact same moral values that he holds. The evidence that our way of living is unsustainable in the long term first appeared when I was a young adult in the late 1960s and early 1970s. It seemed then that we really might be able to bring about a rejection of the consumerism that was ruining our planet.

That was a false hope. Nearly everyone, from the richest to the poorest, wants more. What we need to save Earth is sustainable diminishment, not growth.

Wave of dead trees must be put to good use

17 September, p 13

From Graham Jones,
Bridgham, Norfolk, UK

More dead trees as a result of recent drought in Europe will increase the wildfire risk, so rather than losing individual trees we might lose whole forests and, at the same time, add carbon dioxide to the atmosphere. The deadwood should be removed. It could be used to meet the firewood rush you described (10 September, p 8), where at least it would reduce the need for burning fossil fuels.

However, it would be much more efficient to process the deadwood to generate liquid or gaseous biofuels. Anaerobic heating, or pyrolysis, achieves this, leaving charcoal that could be used as a fuel or returned to the soil as a form of carbon capture. ■

For the record

■ IBM's quantum computer fridge is 100 times colder than space (17 September, p 18).

■ In the study of links between the pandemic and premature puberty, pre-pandemic cases were found to occur at age 7.6, on average, compared with 6.8 during the covid-19 pandemic (24 September, p 8).



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INCLUDE:**

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Professor and Director of the Centre for Language Evolution at the University of Edinburgh

David Eritzoe

Clinical Senior Lecturer in Psychiatry, Imperial College London

Julie Seibt

Senior Lecturer in Sleep and Plasticity, Surrey Sleep Research Centre

Anil Seth

Professor of Cognitive & Computational Neuroscience (Informatics), School of Engineering and Informatics, University of Sussex

Manos Tsarikis

Professor of Psychology, Royal Holloway, University of London

Scan me to book



Songs from the deep

Two eye-opening new books explore the marvellous world of animal communication. They are both must-reads, finds **Chris Stokel-Walker**



Books

How To Speak Whale

Tom Mustill

William Collins

The Sounds of Life

Karen Bakker

Princeton University Press

PASSENGERS taking the train through Port Elizabeth in South Africa in the 1880s – today called Gqeberha – had more than the passing brushland to look at as they crossed the country and stared out of the window. As the train reached a certain signal box, they might have noticed that their safe passage was ensured not by a human, but by a chacma baboon.

Jack, as the baboon was called, was directed to switch the levers affecting the track's configuration by his human companion and keeper, James Edwin Wide. Wide was nicknamed "Jumper" due to his proclivity for leaping between railway cars – a habit that lasted until it went wrong and he lost both his lower legs. Jack helped Wide carry on his work, and they communicated with each other through a series of signals.

The story of the baboon signaller is told in a book called *How to Speak Whale*, though it acts as an adjunct to the main narrative, which is author Tom Mustill's attempt to dig for understanding beneath the burbling of cetaceans, the animals that are believed to be most like our own chatty selves.

Mustill's book is a hugely engaging personal story of a journey into the future of human-animal communication, facilitated by delving into its past. Throughout, the reader is thrown headlong into anecdotes, intimate conversations and detective-like



RODRIGO FRISCIONE/IMAGE SOURCE/ALAMY

inner monologues as the author tries to unpick the extent to which conversations are happening in the animal kingdom without humans recognising them.

"Headlong" is the perfect description: Mustill, a wildlife film-maker, chooses to open his narrative with the story of how he became a viral internet sensation in 2015, after he was almost killed by a humpback whale breaching near his kayak. It is a scene that sets up the rest of the book, which rattles along at a pace that keeps the reader engaged.

A similar title, *The Sounds of Life*, takes a different tack, but is no less interesting. Karen Bakker, a professor at the University of British Columbia, Canada, who works at the intersection of environmental and economic geography, doesn't limit her investigation to organisms or

Cetaceans are believed to be the animals most like our chatty selves

"In 2015, Mustill was almost killed by a humpback whale breaching near his kayak"

environments you might think of immediately. She also devotes time to plants and coral reefs, the latter of which she memorably equates to "an underwater orchestra or the endless improvisation of a jazz band".

Though the books cover similar ground and, in some cases, the same pivotal moments in the history of animal conversation, their styles couldn't be more different. Bakker ladles academic research liberally onto the reader in short, spare sentences that build up to a comprehensive whole. Her deep knowledge is worn lightly throughout the book, so that you never feel overwhelmed. Mustill's style is more conversational, lingering on the made-for-Hollywood moments and delving deeper into the emotions and thoughts of the story's protagonists.

While *How to Speak Whale* professes to focus on whales and their ilk, Mustill makes plenty of detours into other species, at one point telling the story of Alex the African grey parrot, whose name was derived from "avian language experiment". Alex, who lived with comparative psychologist Irene Pepperberg from 1976 to 2007, had similar comprehension and language skills to a 5-year-old child. Despite such asides, both works are bookended with stories of whales and their uncanny ability to communicate, which makes us think more highly of their intelligence than that of almost any other animal.

Bakker and Mustill each unpick how intrinsic communication is thought to be to whales – and highlight that, as much as we profess to know about whale song and its purpose, there is still plenty to learn about how these beasts communicate. The authors also highlight how whales

Uranium fever

Oliver Stone's paean to nuclear power is a little too one-sided, says **Davide Abbatescianni**



Film

Nuclear

Oliver Stone

Release date to be confirmed

AFTER the release of Frankie Fenton's documentary *Atomic Hope* earlier this year, another non-fiction film supporting nuclear energy is about to hit our screens. In *Nuclear*, which recently premiered at the Venice Film Festival, director Oliver Stone trumpets his message loud and clear: renewable energy isn't going to save us from global warming, and nuclear power is the only way to meet the world's growing energy demand.

Stone's thesis is based on the ideas of Joshua Goldstein and Staffan Qvist, taken from their book *A Bright Future: How some countries have solved climate change and the rest can follow*. While we obviously need to reflect on whether nuclear power is a viable option in the effort to halt climate change, the director chooses the worst possible language with which to make his case, talking down

to viewers and repeating ad nauseam how "totally safe" and "clean" nuclear power is. His patronising "voice of God" narration accompanies the film's extensive stock footage, which is interspersed with his visits to nuclear plants, the talking heads of several pro-nuclear experts and the overwhelming presence of Vangelis's bombastic score.

Commendably, Stone doesn't deny the important role of renewable energy in reducing carbon emissions, but he stresses that it can't be our only way out. His explanation for why renewable energy solutions – in particular solar and wind – use too much surface area to be our sole power source is spot on, and is perhaps one of his strongest arguments.

What affects the film's credibility, however, is its lack of contrasting authoritative voices. There is basically no dialogue and no confrontation, with every opponent treated as corrupt and backed by the fossil-fuel lobby. The disasters at Chernobyl and Fukushima are reduced to small, exceptional emergencies, especially when compared with the destruction caused by oil spills or gas explosions. Again, Stone is right, but he overlooks the proven health and safety risks of radioactive waste.

Nuclear is a demonstration of how pushing a message too hard can fail to compel viewers and risks disengaging them. A less partisan approach from Stone – and perhaps a bit more modesty – would have been beneficial to his cause, as would seeing his audience as people in charge of their own brains, not a classroom to be lectured. ■

Davide Abbatescianni is a film critic based in Rome, Italy

Oliver Stone interviews Ashley Finan, director of the National Reactor Innovation Center, Idaho



BRIGHTERFUTURE

sense with sonar, and explain how science has harnessed military-grade microphones and sonar systems to track the underwater conversations that go on while we humans remain oblivious.

These portions of the books are chock-full of colourful characters that could only exist in this world, where researchers are driven by an insatiable need to understand the clicks and hums of entirely different species.

I had expected the two titles to be easily distinguishable: one about whales, the other covering the animal kingdom and beyond. One work seemed at first to be tightly focused around a narrower argument, while I expected the other to be more expansive and less detailed. One seemed to be an archetypal popular science book, while the other – by dint of its extensive references – appeared to be aimed at a more specialist reader.

I thought, therefore, that it would be easy to recommend one over the other, depending on the reader's background, interests and hopes for the book. If you wanted a quick, easy read for a trip, you would pick Mustill's. If you wanted something drier, but more worthy, you would pick Bakker's.

But it isn't such an easy choice. Both authors have confounded my expectations: *How to Speak Whale* is far more detailed and rigorous than you might at first imagine; while *The Sounds of Life* is eminently more readable than you might expect. They should be read together if you want to understand the full marvel of what we know about the ways life communicates on Earth, and to appreciate the many things we have yet to discover. ■

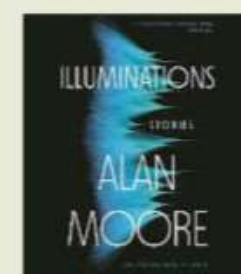
Chris Stokel-Walker is a technology writer based in Newcastle, UK



Read

A Traveler's Guide to the Stars

by physicist Les Johnson introduces the science that could allow interstellar travel. Is it time to revive the dream of settling distant worlds? On sale in the US on 11 October and in the UK on 3 January.



Read

Illuminations

is *Watchmen* author Alan Moore's first short story collection. It contains 40 years of invention, ranging from ghosts and otherworldly creatures to theoretical Boltzmann brains fashioning the universe at the big bang. On sale 11 October.



Visit

The Huxleys, a family whose scientific and literary work has been hugely influential, are discussed by Alison Bashford (pictured) and Adam Rutherford at 7pm BST on 10 October at the Royal Institution in London.

The TV column

Focus on fantasy HBO's *Game of Thrones* turned fantasy into a cultural phenomenon on the small screen; now, rival platforms are rushing to catch up. But fear not – there is still plenty of excellent sci-fi to be found, says **Bethan Ackerley**



Bethan Ackerley is a subeditor at New Scientist. She loves sci-fi, sitcoms and anything spooky. She is still upset about the ending of *Game of Thrones*. Follow her on Twitter @inkerley



Tom Sturridge as Dream in Netflix's adaptation of *The Sandman*

have its own fantasy behemoth to fight in the streaming wars.

But perhaps I am being cynical. The massive budgets poured into TV in the past decade or so mean that fantasy realms once thought unfilmable can finally be realised in their full glory. That is something to be celebrated. And with much of the world engulfed by a plethora of crises – climate change, poverty, disease – it may be the best means to capture the scale of the existential threats facing us. Perhaps the genre is simply rising to meet this moment, casting the brightest light in the deepest darkness.

If you aren't a fan of fantasy and are looking for sci-fi offerings to tide you over, fear not. Two months of Amazon Prime Video from 21 October will let you watch *The Peripheral*, an adaptation of William Gibson's cyberspace novel destined to be the most discussed sci-fi series of the coming months. It will also give you access to *The Expanse*, set during a cold war between Earth, Mars and the asteroid belt, and counterfactual dystopia *The Man in the High Castle*. Paying for one month of Disney+ from 26 October will let you binge a plethora of *Star Wars* content, including *Tales of the Jedi* on its release and the spy thriller *Andor* before its season finale.

The ambitious can take on Paramount+, which boasts 12 *Star Trek* series, including the currently airing third season of *Lower Decks*. And if these sci-fi delights aren't tempting enough, you can live in hope of future adaptations: I would love to see Ursula Le Guin's *The Dispossessed* or *Midnight Robber* by Nalo Hopkinson realised on screen. Here's hoping. ■



Bethan also recommends...

TV
Being Human
Toby Whithouse
BBC

A vampire, a werewolf and a ghost move in together and try to live normal lives: what could go wrong? I guarantee you will want to join this supernatural flat-share, even when things get bloody.

Futurama
Matt Groening and David Cohen
Fox

*On New Year's Eve 1999, pizza delivery boy Fry is accidentally trapped in a cryogenic tube until the year 3000. It is a rare beast that can keep up with the peak of *The Simpsons*, *Futurama's* sister show, but this sci-fi satire is just as funny and twice as clever.*

THROUGHOUT the history of television, science fiction has fared far better than fantasy. Its place in the mainstream was cemented by *Star Trek* and *Doctor Who*, not to mention more recent masterpieces like *Battlestar Galactica*. It is only in the past decade that we have seen a fantasy series become a true cultural phenomenon, thanks to *Game of Thrones*. No other show in the genre has had such an impact.

That might be about to change. August's biggest hit was Netflix's *The Sandman*, a stunning adaptation of Neil Gaiman's comic book series, which follows the uber-goth demiurge Morpheus as he seeks to regain power over his dream realm. In September and October, two fantasy juggernauts have been battling it out for our collective attention: in the red corner, we have Amazon Prime Video's *The Lord of the Rings: The rings of power*, a series as hotly anticipated as it is poorly titled; in the blue corner, there is HBO's *House of the Dragon*, a prequel to *Game of Thrones* that carries on its legacy of courtly

scheming and conspicuous wigs.

Despite my minor gripes, I have enjoyed all of these shows and am looking forward to upcoming fantasy releases, from magical epic *Willow* to the return of *His Dark Materials*. Fantasy television has never been so prominent, nor so promising. But why has the genre's small-screen renaissance only

“House of the Dragon carries on Game of Thrones's legacy of courtly scheming and conspicuous wigs”

come now? And will sci-fi fans be left out in the cold for long?

The whims of streaming service owners and executives may be at play here, at least in the case of *The Rings of Power*. Amazon chairman Jeff Bezos once told staff that he wanted his very own *Game of Thrones*. With a £400 million budget behind this latest attempt, Bezos is driving a televisual arms race in which fantasy may be one more windmill to tilt at. Before long, surely every platform will

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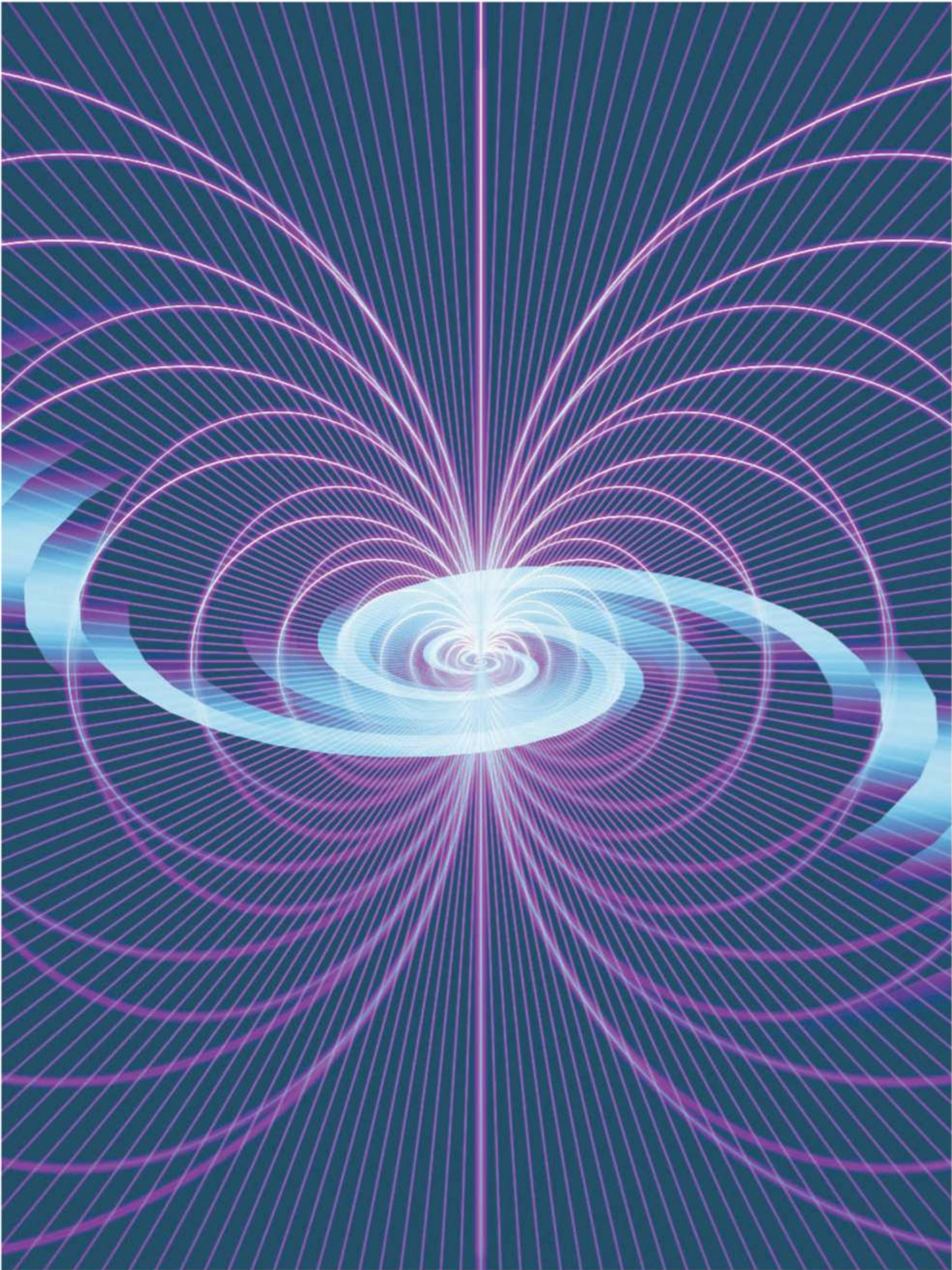
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Features



ANDY GILMORE

Our magnetic universe

The cosmos is full of beautiful structures, but what created them? The surprising answer seems to be: not just gravity. **Stuart Clark** reports

THERE are few places on Earth where conditions get as extreme as they do at the National Ignition Facility near Los Angeles. At its heart, 192 lasers are trained on a gold cylinder roughly the size of an AA battery. As the beams converge, the temperature in the test chamber leaps to 100 million °C, hotter than the centre of the sun.

The facility was built to investigate the possibility of harnessing nuclear fusion, which promises unlimited clean energy. But earlier this year, researchers announced that its powerful lasers have also been directed at a different kind of big question – what shaped the universe?

The cosmos is a beautiful place. At the largest scales, a vast web of matter is woven throughout space. Zoom in and you see galaxies cluster in billowing clouds, while the individual galaxies themselves come in a wondrous array of shapes, including elegant spirals like that of our Milky Way.

For decades, it has been thought that only gravity has what it takes to sculpt such wonders. Now, hot on the heels of a slew of intriguing galactic observations, laser-fired experiments are throwing up hints that we may have wrongly dismissed the influence of another force.

Magnetism has always been considered too weak to be a cosmic sculptor. But those behind the latest results claim that in the white heat of the test chamber, they have caught a glimpse of how this forgotten force can be turbocharged. If so, we might have to find a new place for magnetism, alongside gravity, in our picture of how

the cosmos came to look the way it does.

What we know about gravity and the structure of the universe began to take shape at pretty much the same time. Back in the early decades of the 20th century, astronomers such as Edwin Hubble were beginning to observe the true scale and structure of the cosmos. About the same time, Albert Einstein published his monumental theory of gravity, general relativity. Initially, the theory seemed to fit the observations like a glove and so scientists thought the structure of the universe must be down to gravity alone.

But as observations improved, inconsistencies cropped up. One of the most famous came in the 1930s, when astronomer Fritz Zwicky showed that galaxies in one cluster were moving so quickly that they ought to fly apart instead of being trapped in orbit around one another. He suggested that some form of “*dunkle Materie*”, or dark matter, must exist there – something we can’t see, but which generates extra gravity to help the cluster stick together. From then on, dark matter became an essential prop for gravity theorists, even though no one has ever directly detected it.

In the middle of the 20th century, a different view of what was shaping the universe emerged, courtesy of physicist Hannes Alfvén. Gravity had made the early running because, although it is a relatively weak force, it acts over vast distances and pulls on all matter. Magnetism wasn’t on the table, being a more limited force that only affects electrically charged particles. Alfvén pointed out, however, that much of the stuff in the universe is in a state of matter called plasma, a gas made of

charged particles. He suggested that the force exerted on plasma by magnetism ought to be at least comparable with the effect of gravity on other matter. Magnetic fields must, he reckoned, play an important – perhaps even dominant – role in shaping the cosmos.

Alfvén’s backers began devising hypothetical magnetism-based solutions to several cosmic conundrums, including how spiral galaxies get their shape. But there were always two big problems for those in magnetism’s corner. First, it was hard to test the idea because, at the time, there was no practical way of observing magnetic fields in the wider universe. Second, and more fundamentally, a magnetic field would have to acquire extraordinary strength to play a role in shaping galaxies and no one had any idea of how a sufficiently strong field could be formed.

To create a magnetic field, you first need a dynamo, a churning region of charged, electrically conducting material. This is what happens inside Earth: liquid metal circulates to produce the magnetic field that surrounds our planet. A dynamo made of plasma could certainly have formed in the early universe. The trouble is, any such dynamo would be relatively small fry, generating magnetic fields far too weak to do any real galactic shaping. Something would have had to somehow amplify those nascent fields many times – and no one had any sensible suggestions for how that could have happened. Arguments about what, if any, role magnetism played in shaping the cosmos simmered for decades. But by the 1980s, with no answers to these two problems, magnetism was deemed to have lost. Gravity ►

really was the one true sculptor of the universe. “Cosmic magnetism is generally the last physical mechanism that anybody talks about,” says astronomer Enrique Lopez Rodriguez at Stanford University in California.

Which isn’t to say gravity can explain every detail of the structure of the universe. One puzzle involves galaxy clusters, which, as well as the galaxies themselves and (presumably) some dark matter, contain relatively empty areas called the intracluster medium, in which there is nothing but plasma. This plasma emits X-rays, which we can measure from Earth and so infer its temperature. Since the late 1990s, astronomers have been finding that the plasmas inside galaxy clusters are inexplicably hot, at 10 million °C. According to gravitational physics, the gas should have radiated away that heat long ago.

Although this particular puzzle didn’t immediately turn astronomers back towards magnetism, some researchers have recently been wondering if we were too hasty to dismiss the force so completely from cosmology. One thing that has changed since the 1980s is our ability to look for magnetic fields in the universe. Take NASA’s Stratospheric Observatory for Infrared Astronomy (SOFIA) instrument, an infrared telescope housed in a converted jumbo jet that can soar high into the atmosphere. It climbs above the water vapour in the air, which absorbs infrared light and stymies most infrared observations attempted from the ground.

When cosmic dust grains find themselves in a magnetic field, they line up like a picket fence, which polarises any infrared light passing through them. Lopez Rodriguez happened to be working with SOFIA five years ago when the researchers were commissioning a new

“The magnetic field lines were clearly following the spiral pattern of the galaxy. Gravity didn’t predict anything like this”

instrument that could pick up these signals and so reveal magnetic fields. He suggested they observe the spiral galaxy NGC 1068, the core of which was known to be a source of polarised infrared light. In the first 30 minutes of the observation, they saw something extraordinary: the magnetic field was clearly following the spiral pattern of the galaxy (pictured above). Gravity didn’t predict anything like this. “I was like, whoa, what is going on here?” says Lopez Rodriguez. To find out if this was a fluke, they looked at 20 other nearby galaxies. “So far, every single one has a large-scale magnetic field permeating the

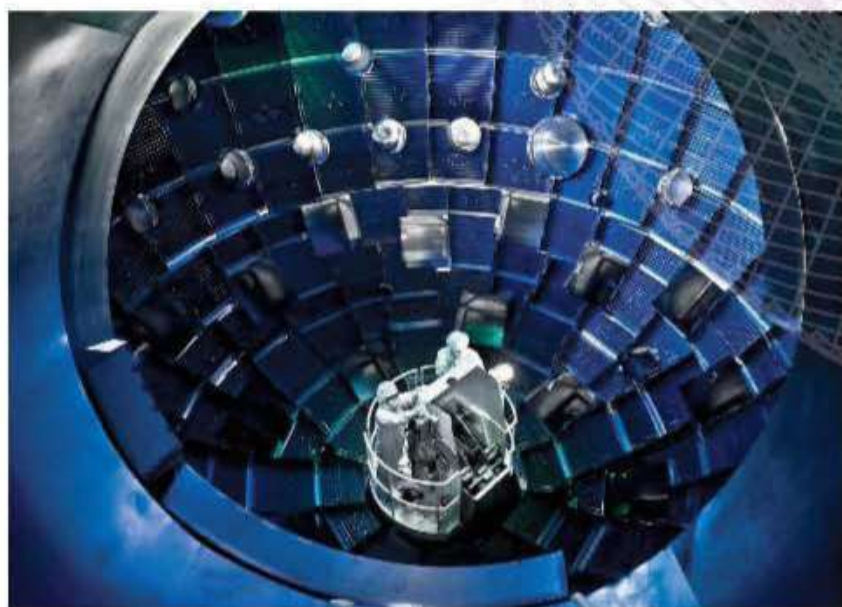


whole galaxy,” says Lopez Rodriguez. And these fields all follow the shape of the spiral arms too.

Other telescopes have seen similar things. In 2020, Yelena Stein, now at the German Aerospace Centre in Cologne, and her colleagues used the Very Large Array – a radio telescope in New Mexico – to study the spiral galaxy NGC 4217. They detected a large-scale magnetic field permeating the galaxy.

On their own, these observations are hardly conclusive. The magnetic fields could be a side effect of the spiral shape rather than a cause of it. And the reasons for ruling out magnetic fields as cosmic sculptors weren’t just that we hadn’t seen them, but that we didn’t understand how they could be sufficiently amplified.

Now, however, that second objection might be crumbling too. Ever since the mid-1950s, when geophysicist Stanislav Braginsky wrote down his equations of fluid motion in a plasma, researchers have been interested in the role of turbulence – chaotic changes in pressure and flow – in the generation of a magnetic field. One idea that emerged was that turbulence within the plasma could affect the properties of the magnetic field generated. Turbulence is inherently complicated and it was impossible to understand what effects it might have until the advent of modern computer simulations. But these have shown that a “turbulent dynamo”, as it is known,



At the National Ignition Facility's target chamber, temperatures can top those at the centre of the sun

PHILIP SALTONSTALL



NASA/SOFIA; NASA/JPL-CALTECH/ROMA TRE UNIV.

NASA's SOFIA telescope, housed in an aeroplane (right), captured images (left) of magnetic fields following the spiral pattern of a galaxy called NGC 1068



NASA/JIM ROSS

glimpse of a turbulent dynamo in action.

Emboldened, the researchers wanted to see the effect in its full glory, which meant using a more powerful laser to drive the turbulence even harder. That was what brought them to the world's most powerful laser apparatus, the National Ignition Facility at Lawrence Livermore National Laboratory in California, with its 192 laser beams. It is rare for scientists to be granted time on the laser for experiments on anything other than fusion, but Meinecke's team secured permission and got to work.

The researchers' first "shot day" came later in 2018. They performed a similar experiment to the one at Omega, watching with X-ray cameras to see what happened. They were expecting a sharp increase in the plasma's temperature, but instead the cameras captured a patchwork of hot and cold spots. "It was like looking at a Dalmatian," says Meinecke. "I showed it to the team and they said 'there's no way that can be the result.'" But the experiment was redone and it was always the same.

That was when the penny dropped. The turbulent dynamo effect the researchers had created was so strong that the resultant magnetic field was trapping particles inside certain regions of the plasma. It was enough to reduce the flow of heat by a factor of 100, creating the hot and cold spots. The team has spent years double and triple-checking the results and only went public with them a few months ago. Plasma physicist Patrick Diamond at the University of California, San Diego, says this is "a significant step forward". He points out that his own field, nuclear fusion, relies on strong magnetic fields to trap energy and heat, but it does so using strong, uniform fields. "This is the first case where you see this reduction in thermal diffusivity as a consequence of a chaotic or turbulent magnetic field," he says.

This unexpected ability of the magnetic fields to trap heat could solve the puzzle of the inexplicably hot intracluster medium in galaxy clusters. Meinecke and her team are proposing that the magnetic field created by a turbulent dynamo could hold plasmas in place, and suppress the diffusion of heat for billions of years. "The magnetic field contains enough energy that it can tell the matter how to move," says Gregori – just as gravity does. Indeed,

when they first saw that Dalmatian-like pattern of hot and cold spots in their turbulent plasma, they were struck by how similar it looked to the structures we see in galaxy clusters.

All this is breathing new life into Alfvén's argument that magnetism helped sculpt the universe. It is tempting to ask if this could even banish the need for dark matter. That is a step too far for Stein, though. "I think it's not that we need less dark matter or more dark matter, it's just that we need to understand how these processes work," she says. In other words, astronomers need to start taking magnetic fields a lot more seriously.

It is a challenge Lopez Rodriguez is willing to accept. He, too, is sceptical that magnetic fields in spiral galaxies are strong enough to replace dark matter, but the truth is that no one knows what modifying effects they may have. His first investigation is into why magnetic fields seem to ubiquitously follow the spiral pattern of their host galaxies.

According to gravity theorists, spiral galaxies are explained by something called density wave theory. It posits that as matter orbits the centre of a galaxy, slightly more dense regions slow down other patches of passing matter, enhancing the first region's density, sparking star formation and delineating the spiral arms. The one thing it doesn't predict is why a large-scale magnetic field would follow this structure so precisely, but then neither does any dynamo theory. "Yet we see it everywhere," says Lopez Rodriguez.

To find out what is going on, he will soon begin a three-year programme of computer modelling, running simulations of galaxy formation with and without the fields to see what comes out. If all goes to plan, he will finally have some answers and perhaps we will at last know how the cosmos was chiselled into shape. ■



Stuart Clark is a consultant for New Scientist. His latest book is *Beneath the Night* (Faber)

should hugely boost a magnetic field's strength. Still, these effects would only become easy to observe in a plasma heated to extreme temperatures – the sort present during the early universe – which meant this was a tough hypothesis to experimentally test.

Step forward Jena Meinecke at Oxford University, who has for years been investigating the turbulent dynamo as part of an international team of plasma physicists. "It's the holy grail, in some ways, of plasma physics," she says. The emergence of large laser laboratories has been a godsend because they are the only places capable of creating a plasma hot enough to get close to the conditions where a turbulent dynamo can be studied.

Fire the laser

Meinecke's team, led by Gianluca Gregori at the University of Oxford, did its first laser experiment in 2018. At the Omega Laser Facility at the University of Rochester in New York, the researchers created a small "forest" of targets made of foils and grids on poles that they calculated would disrupt the plasma in a turbulent way. The laser then zapped a capsule of deuterium, a heavier form of hydrogen, and turned it into a plasma, which, thanks to the grids of foil nearby, swirled with turbulence. The researchers saw a rapid amplification of the plasma's magnetic field – the first ever

THE middle of the 19th century was the heyday of Egyptology. Hieroglyphs had been deciphered and people could finally grasp the full richness of the ancient Egyptian civilisation. The pyramids, the mummies, the statues – it all came to life. But some European Egyptologists felt the best was yet to come. As they worked their way further south, they believed they would find older relics, perhaps even the cradle of the Egyptian culture.

In this atmosphere, Prussian archaeologist Karl Richard Lepsius began an expedition up the Nile valley. Late on 28 January 1844 he reached Meroë in what is now Sudan and found a scattering of pyramids. But even by the light of his candle, he could see the structures weren't as old as he had hoped. As he investigated further, he concluded they weren't Egyptian.

Lepsius later drew a dividing line between

ancient Egypt and the people who built the pyramids at Meroë, who belonged to a separate civilisation called Nubia. In the next century, researchers followed his lead and saw Egypt as sophisticated, and Nubia as its inferior neighbour. Egyptian artefacts were given pride of place in museums, Nubian work was largely ignored.

But attitudes are changing. Fresh research is bringing ancient Nubia out of the shadows and its story can now be told. These were diverse peoples with their own beliefs and customs. Far from being a boring backwater to Egypt, the Nubians exchanged cultural ideas with their neighbours, even setting fashion trends for kings like Tutankhamun. In truth, we can't grasp the history of this part of the ancient world without understanding both Egypt and Nubia together.

Ancient Egypt is arguably the most famed of the ancient civilisations. With its pharaohs

and fabulous treasures, it captures the imagination. The Egyptian civilisation, which broadly covered the northern two-thirds of modern Egypt, is rightly seen as impressive, with a writing system, legal codes and careful civic organisation.

Ancient Nubia is less well known, and for decades the little that was understood about its people came from Egyptian texts and artworks. From these, scholars learned that Nubia was rich in natural resources, including gold, that their neighbours to the north coveted and occasionally controlled. They also noticed that the Egyptians generally depicted Nubians as Black and often described them using negative language. Nubian people they captured during raids often became slaves.

It is fair to say that all this tainted researchers' views over the past century. Influenced by outdated racist and colonialist views, some saw Egypt as a great power

Finding Nubia

We are finally learning what ancient Egypt's mysterious neighbour was really like, says **Colin Barras**

exploiting its weaker neighbour. Today, however, we are realising that this framing of Nubia could have blinded us to its true character and many are seeking out new evidence and reconsidering old artefacts.

As the true nature of ancient Nubia comes into focus, it is becoming clear how complicated the region's history is (see "The rise of Nubia", page 40). Many researchers now argue there was rarely a common Nubian identity. Although there are some overarching similarities in the pottery produced across ancient Nubia, the archaeology in its north is typically distinct from that to the south, and both are distinct again from the archaeology of the desert region of eastern Nubia. "There are sometimes three or four different cultures active at the same time," says Aaron de Souza at the Austrian Academy of Sciences in Vienna.

The earliest culture to appear in ancient Nubia, starting in around 3800 BC, is known

to archaeologists as the A-Group. We know relatively little about these people – not even how they referred to themselves – but we have discovered some of the rock art and graves they left behind.

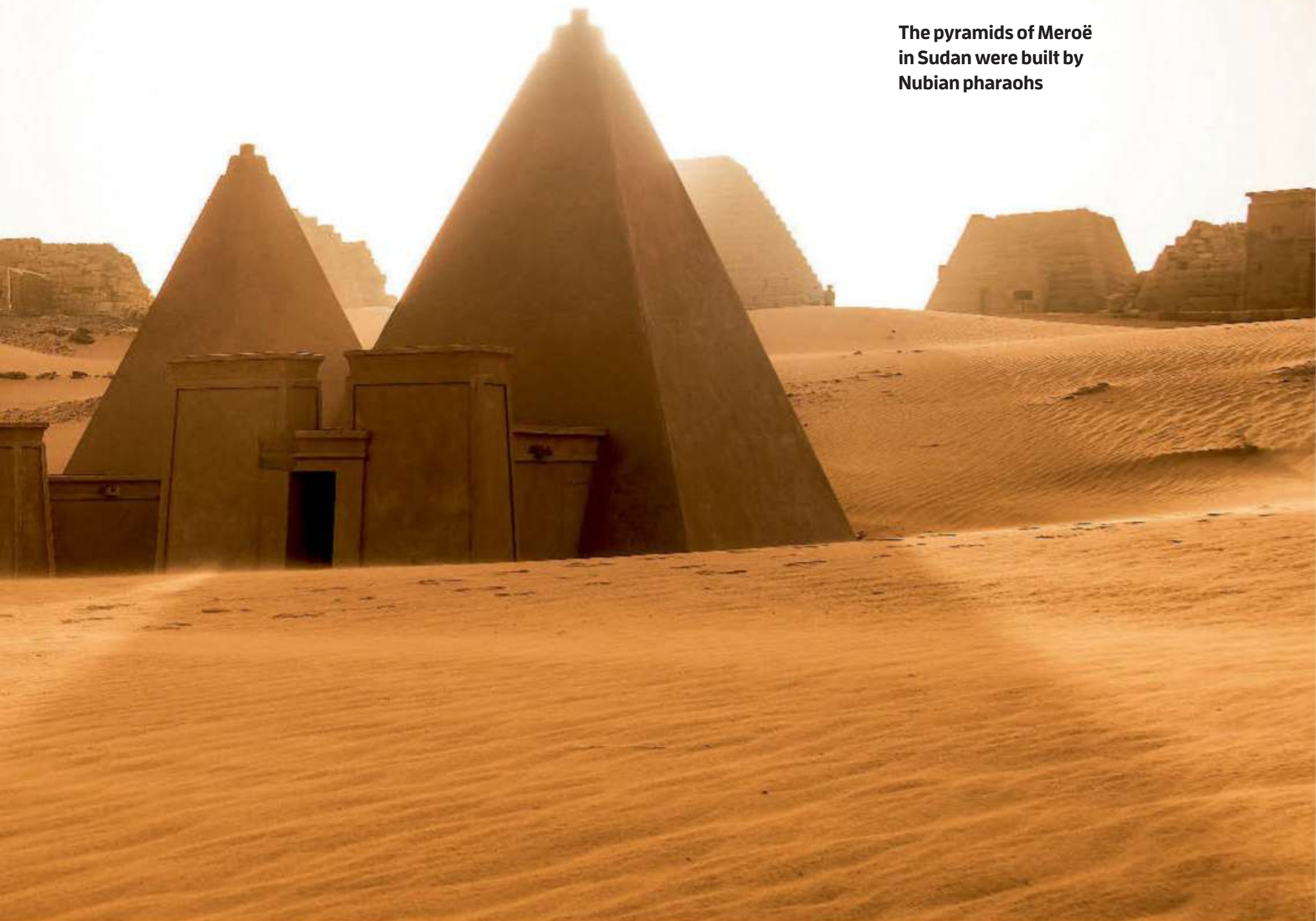
By around 2500 BC, the A-Group had disappeared and there were at least three groups living in the area. A culture called the C-Group, based around cattle herding, had emerged in the north. There was also a group of farmers who lived in large settlements, called the Kerma culture, in the south. To the east, an unnamed group of herders wandered the deserts, and these people would give rise a few centuries later to the Pan-Grave culture, so named because they are mostly known from the graves they left behind.

All three were ancient Nubians, but each was also apparently keen to carve out a unique identity. This is particularly obvious for the C-Group people, says Henriette Hafsaas at

Volda University College in Norway. Her research over the past 20 years suggests these people were never sold on the concept of an afterlife, unlike the Kerma people and the Egyptians. This idea is based on the fact that C-Group individuals went to the grave with few of the possessions that their neighbours considered vital for life after death. Instead, C-Group people placed pottery outside the graves, suggesting they venerated their dead family members as ancestors. "They did things differently," says Hafsaas.

Not only was ancient Nubia not a homogenous mass, it also wasn't as separate from Egypt as Lepsius thought. By around 2000 BC, the Kerma people established the Kingdom of Kush, a political force centred at the large, fortified city of Kerma. And by around 1800 BC, raiding parties from Kush were attacking Egypt. This would have triggered counter-attacks from Egypt, says ➤

**The pyramids of Meroë
in Sudan were built by
Nubian pharaohs**



CHRISTOPHER MICHEL

Hafsaas, and the C-Group people found themselves caught in the middle between two powerful fighting forces.

They had to seek an alliance for protection. But Hafsaas's research in recent years suggests they didn't choose their "fellow" Nubians from Kush. After analysing Nubian archaeology and Egyptian texts, Hafsaas concluded that the C-Group people sided with the Egyptians, and eventually became assimilated into that society to some extent. "Despite all the well-established efforts in the academic field to create these archaeological cultures and fit them into boxes, it doesn't really work," says Julia Budka at the University of Munich, Germany, whose research has explored Kushite-Egyptian relations.

Tjehamau speaks

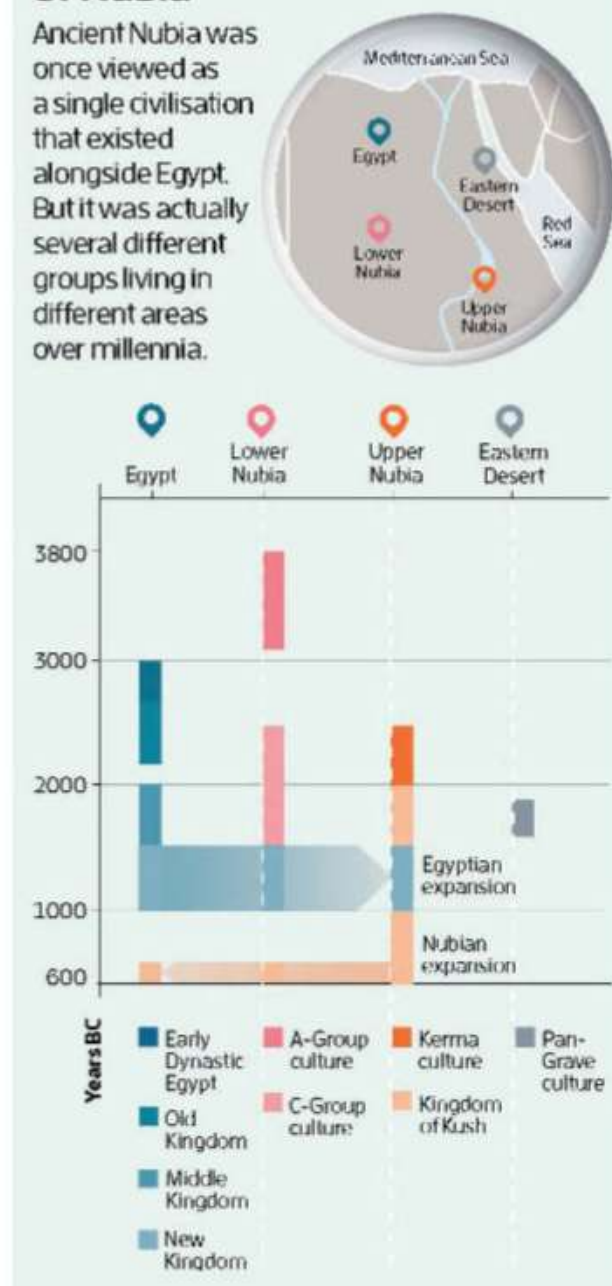
What it was to be an ancient Nubian seems to have varied between individuals too. For evidence of this, look no further than a Nubian soldier named Tjehemau, who was born around 2050 BC. He is thought to have been from a C-Group community, where he may have been trained as a warrior to guard the family herds. At that time, many such men travelled north seeking well-paid work as mercenaries in Egypt, where their fighting skills were prized. One Egyptian tomb from about 2100 BC even includes figurines of Nubian archers.

Unlike Egypt, none of the early ancient Nubian cultures developed writing. But Tjehemau, who was exposed to Egyptian culture, did leave behind written material, possibly produced by a scribe on his behalf. Inscriptions on a rock in the Nubian desert record thoughts he poured out about his life and achievements. John Darnell at Yale University analysed Tjehemau's text about 20 years ago. "He contrasts his bravery to the cowardice of [ancient Egyptian] troops," says Darnell. More significantly, Tjehemau takes credit for being an important fighter who helped the Egyptian pharaoh Mentuhotep II gain great power – which the pharaoh then used to take control of Tjehemau's home region of Lower Nubia around 2040 BC for a period. The inscription is "rather remarkable", says Darnell. It shows that some Nubians adopted Egypt as their home – so much for the stark dividing line.

Some of the newest work on ancient Nubian societies is providing perhaps the most touching insights. De Souza studies archaeological sites related to the Pan-Grave

The rise of Nubia

Ancient Nubia was once viewed as a single civilisation that existed alongside Egypt. But it was actually several different groups living in different areas over millennia.



culture, a group of herders known for their simple, but distinctive, pottery and for the way they buried their dead. They tended to place bodies in shallow graves and surround them with cattle and goat skulls that had been carefully painted with abstract patterns.

In 2017, he helped excavate a Pan-Grave cemetery site in Hierakonpolis in modern day Egypt. The graves had been covered in a thin layer of mud, which was marked all over with hand prints. It could have been that the dead person's relatives had pressed their hands into the mud as a final act of saying goodbye. At one point, de Souza placed his own hand into one of the 3800-year-old prints, replicating a gesture made by a member of the ancient community. It was a deeply moving experience, he says.

He also worked on the excavation of a child's burial at the same site, and in the mud around the body there were ancient footprints – evidence of a funeral, with people gathered at the graveside. One of the footprints was half underneath the basket in which the little body had been placed. "Whoever's footprint that was, was the person who put the basket down," says de Souza. The sad scene came instantly and vividly back to life. "I actually cried during that excavation," he says. Work like this is helping to show that the Pan-Grave community wasn't a cultural backwater to be looked down upon in comparison with Egypt, but a community suffused with its own customs.

Blurring boundaries

Even more telling, de Souza has been studying how the Pan-Grave people interacted with ancient Egypt. We already knew that from about 1800 BC some of them had migrated from Nubia's eastern desert to settle in Egypt. It was assumed that these people lived on the margins of Egyptian society and had no influence on it. But in a lecture at The Metropolitan Museum of Art in New York earlier this year, de Souza explained how pottery evidence suggests otherwise. He has discovered examples of pots from Egyptian settlements that were clearly made using Egyptian technology – a potting wheel – but which bear Pan-Grave motifs. Were the pots made by Nubians using Egyptian techniques or by Egyptians borrowing their designs? Whichever is the case, de Souza told his audience, the boundaries between the two cultures were blurring.

This blurring goes high up the ranks of Egyptian society. Tutankhamun's gold death mask is a quintessential symbol of ancient

“Tutankhamun had pierced ears – but this was originally a Nubian tradition”

The Pan-Grave culture is known for its cattle skulls painted with geometric patterns. Pottery from Kush (top) and Meroë (bottom) was richly decorated



GUSTAVO CAMPOS

Egyptian culture. It shows the boy king had pierced ears, as did many pharaohs at that time. But this was a Nubian tradition, points out de Souza, one that Egypt seems to have adopted a few generations before Tutankhamun's reign.

Still, in telling the story of ancient Nubia and Egypt, we can't forget that it unfolds over nearly three millennia and a lot changed during that time. Much of the recent research has been showing how the early Nubians were sophisticated in their own right. But we have long known that later in the region's history, around 1500 BC, pharaonic Egypt became so extraordinarily powerful that it could invade and rule over the Kingdom of Kush. The ancient Egyptians built towns and temples as far south as Kerma and the people living in Nubia were brought into the fold and used to run this part of the empire.

Budka suspects this had a profound effect on the ancient Nubians. Egyptian rule persisted for centuries. As the years rolled on, Nubian people began to see aspects of the Egyptian belief system and architecture as part of their heritage. When Egyptian rule ended and the ancient Nubians regained control of the Kingdom of Kush, they continued to use and develop many Egyptian traditions – because by then they had become Nubian traditions too.

In time, a powerful new force emerged in Kush, the Napatan dynasty, which by 745 BC, had swept north and taken control of all of Egypt. The pendulum had swung the other way, and for nearly a century, Egypt was ruled by Nubian pharaohs, who were buried in

tombs beneath pyramids in southern Nubia.

It was during this time that the pyramids at Meroë were built, the ones that Lepsius discovered by candlelight. In years gone by, researchers have argued that the ancient Nubians built these structures because they were consciously mimicking the ancient Egyptians to justify their right to rule as pharaohs. But Budka thinks there is more to it; the ancient Nubians had been so exposed to ancient Egyptian practices that pyramid burial wasn't a foreign custom. "It was part of their cultural heritage," she says.

Even today, the region that was once ancient Nubia is a melting pot of differences. During a coup in Sudan in 2019, for example, female protest leaders called themselves Kandake, an ancient Kushite term for queen. "People would sing songs, and say they originated from a very strong people," says Sami Elamin, an

The city of Kerma is one of the largest archaeological sites from ancient Nubia



PANTHERMEDIA GMBH/ALAMY

archaeologist and inspector with Sudan's National Corporation for Antiquities and Museums. But the dominant religion in Sudan is Islam, and many people trace their ancestry to the Arabian peninsula, not ancient Nubia, says Mohamed Faroug Ali at the International University of Africa in Khartoum, Sudan. "They are more likely to look at Islamic history than Kushite history," he says.

To complicate things further, communities that consider themselves Nubian still exist in Sudan and Nubian languages are still spoken – and for some in these communities, the connection with ancient Nubia can feel stronger. For the past 20 years, Ali has been working with Michele Buzon of Purdue University in Indiana at a site called Tombos near Kerma. "We were excavating the burial of an elderly woman, and the locals on site said: 'Oh, this must be my grandmother,'" says Buzon. "It was said in a friendly way and not meant literally – but there is clearly some personal connection there."

Even if attitudes vary across Sudan, there is agreement on one important point. No one shares the 19th-century view of ancient Nubians as inferior to the ancient Egyptians. "I would say people from all across Sudan are proud of their culture," says Elamin. The rest of the world is finally starting to catch up. ■



Colin Barras is a features editor for *New Scientist*

Hack your metabolism

Everybody's metabolism is different, so how can you understand yours – and turbocharge it for a fitter, healthier you? **Catherine de Lange** investigates

MY FAMILY holidays in France are synonymous with one thing: bread. But this year, as everyone else sits down to their croissants and baguettes, my plate is bare. Before even my first sip of coffee, I have to take a long, slow inhalation through a handheld device resembling a sleek electronic cigarette, hold my breath for 10 seconds, then exhale through the mouthpiece. Instantly, an app on my phone delivers the verdict as a score from 1 to 5. Today, it is a 1, and I am elated. For the first time in weeks, I have woken up in “fat-burn mode”. I have taken my first steps to hacking my metabolism.

Usually, I would be the first to roll my eyes at any gizmo associated with weight loss and healthy eating. You don't need an app to tell you which foods are good or bad. Or do you? Evidence has been mounting that suggests the one-size-fits-all advice on nutrition is drastically failing us, and that we have been thinking about metabolism – the chemical reactions in your cells that change food into energy – all wrong. Against this backdrop, many new technologies are hitting the market, claiming to reveal what your metabolism is doing as you go about your day – and giving tips on how to improve it. Make the right tweaks and you could find it easier to manage your weight, ward off disease, sleep better, and more. I wanted to understand how much of a difference such changes could make and whether ignoring the new science might be leading me to metabolic meltdown.

Dietary advice used to be straightforward: to maintain a healthy weight, calories in and out should roughly match up. If you ate too much, you could burn it off with exercise. And it was widely accepted that your metabolism slows with age, accounting for that middle-age





spread. Finally, specific foods were thought to trigger the same response in everyone – a banana was as good for you as it was for me.

Over the past decade, however, each of these tenets has been dismantled. The problem is that metabolism is extremely complex, and trying to measure what a person is doing at any point in time has typically required some pretty elaborate equipment, so studies only involved a small number of people. This means that standard advice had to be generalised. But start to look at the individual and a very different picture emerges.

Let's take the question of calories, used to express the energy content of food. General advice suggests that men should consume 2500 calories and women 2000 each day. "But it's a total guess," says epidemiologist Tim Spector at King's College London.

He should know. One gold-standard way to see what someone's metabolism is doing is to put them in a sealed room, pump fresh air in and continually analyse the amount of carbon dioxide and oxygen. That's because oxygen is used by our cells as they work, producing carbon dioxide that is ultimately exhaled. When Spector spent 24 hours in such a metabolic chamber, he discovered that the amount of calories he burned while doing nothing was less than 1600. "If I'm having a 2500-calorie diet, it's going to be very hard for me to balance it every day," he says.

Surely exercising should help him get rid of those extra 900 calories? Not so fast. In the past few years, Herman Pontzer at Duke University in Durham, North Carolina, and his colleagues have conducted studies of the Hadza people in Tanzania, who live a very active hunter-gatherer lifestyle, and found that, despite this activity, they burn around the same calories as someone sitting at a desk all day. It turns out that you can't outrun a bad diet. Pontzer has also laid to rest the idea of middle-age spread. It seems our metabolism stays pretty constant until around the age of 60.

When it comes to the food we eat, things are even more surprising. Work by Spector and others has shown that if two people – even identical twins – eat the same food, their bodies' reactions could vary wildly. One might have a huge spike of glucose after that banana, followed by a sugar crash and accompanying hunger pangs, whereas the other would see only a gentle rise and fall in blood glucose levels and feel satiated until lunch.

Where does all this leave us? For a start, it is clear that every individual has a very different metabolism, and possibly one that responds differently at varying times of day and at

different stages of life. What's more, traditional ideas about how to keep metabolism in check aren't going to work. It is no wonder, then, that people are turning to technologies that could help them better understand what is going on.

The device I am using is made by a company called Lumen. Like Spector's own personal nutrition firm, Zoe, the first thing Lumen does is throw away the concept of calorie counting. "Purely calorie-controlled diets don't work," says Spector. Instead, the companies focus on macronutrients, the core components of our diets – in particular protein, fat and carbohydrate, the last two of which are the only types of fuel our bodies can use. Protein is important for building muscle, but isn't used as a direct energy source, except in extreme cases where all available carb and fat stores have been used.

Favourite fuel

If carbohydrates, which are present in the blood as glucose, are available, the body will prefer to burn these over fats. "Everything in your body is designed to prevent you from burning fat," says Spector. Metabolising fat is hard for the body – it requires more chemical reactions than metabolising carbs, so provides less energy in the same amount of time.

This is the key concept behind the Lumen system, which was devised by twin sisters Merav and Michal Mor, both physiologists and endurance athletes. Anyone competing in endurance events is acutely aware of the body's preference for carbs over fats. Once you run out of carbs, you tend to "hit the wall", where muscles feel heavy and everything tells you to rest. The twins wanted to devise a way to hack their metabolism to improve their ability to burn fat, so they could fuel themselves better for their Ironman races. They soon realised this might also be useful for anyone who wanted to improve their metabolism.

Lumen claims to be able to monitor whether your body is burning carbs or fat in real time and to train it to switch between the two, burning fat when you want it to and using carbs only when you need that disposable energy. It works by monitoring the amount of carbon dioxide and oxygen in your breath, replicating a test of metabolism that has, until now, only been available in a laboratory setting. The accuracy of the device was verified against the lab version in a small, peer-reviewed study.

Aside from losing weight, there are other reasons why you might want to know whether your body is burning carbs or fats, and get better at swapping between the two. Being

able to easily switch between burning fats and carbs is a measure of metabolic flexibility. And it turns out that being metabolically flexible could be hugely beneficial for your health.

The term "metabolic flexibility" was first used in the 1980s to describe an unusual ability of parasitic worms, which could switch between using different energy sources depending on their environment. Scientists started to wonder how important metabolic flexibility was to our own health. They found that people who were lean and healthy were good at using up glucose in the blood, and that people who were overweight had a lower capacity to burn carbohydrates. They were also interested in whether or not people were able to switch their fuel source depending on whether they needed a burst of energy for exercise. The answer emerged: people who are metabolically flexible rely on fats after not eating for several hours, then shift to carbohydrates after they have eaten. They find it easier to burn through the carbs available and switch back to fats when necessary. Importantly, the ability to shift between the two was a marker of overall metabolic health.

The question then was whether we can help people to improve their metabolic flexibility,

says Audrey Bergouignan at the University of Colorado, Denver.

This is where Lumen aims to help. The idea is that by switching more often between burning fats and carbs, you can train your body to do it more efficiently. This tallies with my experience. For the first couple of weeks, I found it impossible to avoid getting a reading of at least 4 on the 5-point scale, where a 1 or 2 indicates fat burn, 3 suggests you are burning both carbs and fat, and 4 or 5 is a total carb fest. Waking up in a state of fat burn is one of the most important ways of testing metabolic flexibility. "Overnight, your body has time to burn through all of your carb stores. You should be like an empty tank," says Kayla Blumenfeld, PR manager at Lumen. Then, when you start eating again, you fuel your day without an overload of carbs.

This is important because if you have carbs in your bloodstream constantly, your body doesn't have a chance to get in the mode of burning fats. Thankfully, you aren't trying to cut carbs from your diet completely. In fact, to encourage metabolic flexibility, Lumen will suggest a low-carb quota if you wake up burning carbs. Once you are better at burning fat, it will recommend high-carb days to keep your metabolism on its toes, making that important switch.

Research indicates that being metabolically flexible is key to beating metabolic syndrome, which is a cluster of symptoms such as high blood pressure, high cholesterol and obesity that puts you at greater risk of heart disease, type 2 diabetes and stroke. Indeed, studies show that people with metabolic syndrome are much worse at switching between carbs and fats – they are metabolically inflexible.

Of course, it could be that they are metabolically inflexible because they already

"Just three days of physical inactivity can make you metabolically inflexible"



How to hack your meals

The advent of continuous glucose monitors has revealed that even those who consider themselves healthy eaters can experience large spikes in blood glucose levels that could predispose them to diabetes, premature ageing and energy slumps (see main story). Thankfully, there are simple ways we can all keep our blood sugar levels, well, level.

One is the order in which you eat your food, which studies show can significantly impact your glucose response. To minimise a post-meal surge in glucose, you should start with fibre, such as veg, follow this with protein and end with any carbs and sugars. The fibre lines your intestine and the protein slows down digestion. Taken together, this will mean that the carbohydrates are digested more slowly, causing less of a steep rise in blood sugar levels. For the same reason, if you have a sweet tooth, it is wise to get that sugar hit at the end of a meal rather than a few hours later as a snack on an empty stomach.

Another trick is to eat whole foods and fibre that also contains starch to slow down digestion. Finally, avoid too much stress, which research shows prompts your body to release lots of glucose to give you the energy to fight or flee – not necessary when you are sitting down for dinner.

have health issues. To get to the bottom of this, Bergouignan and her team went to the extreme. They knew that habitual physical activity is a good predictor of metabolic flexibility, so they took a group of women without any significant health problems and confined them to bed rest for two months. The participants were fed a balanced diet, and yet not only did they become metabolically inflexible, they also became worse at controlling their blood glucose levels – predisposing them to metabolic syndrome. In addition, long-term research has found that metabolic flexibility is a predictor of how much body fat and weight gain a person will go on to have five years later.

The takeaway from all this is that metabolic flexibility is to be taken seriously. Luckily, we can improve it, with exercise being one option. Bergouignan's bed-rest studies may have been extreme, but her team has discovered that the same things happen when people simply take fewer steps.

Get moving

Certainly, one of the biggest predictors for me of whether I wake up burning fats is whether I have been physically active the day before. The key is to exercise regularly, though. In research due to be published soon, Bergouignan's team found that just three days of physical inactivity can make you metabolically inflexible.

Responsible fasting is another way to improve metabolic flexibility by giving your body enough time to burn through all of the blood glucose from carbs and switch to using fats. Your body doesn't need large amounts of energy at night, so Lumen advises that you stop eating a couple of hours before you go to bed.

By pooling data from thousands of those using its devices, Lumen has also discovered surprising patterns that could help people improve their metabolic health. For instance, it found that 40 per cent of users fast for too long, putting their body in a state of stress. Stress, as well as poor sleep, promotes the production of cortisol, a hormone that can interfere with metabolism and result in surges in blood sugar.

Aside from the risk of diabetes, such surges are bad for us because regular periods of high blood glucose have been linked to lethargy, ageing of the skin and an increased risk of cancer and dementia, as well as causing damage to blood vessels, which could increase heart disease risk. "It causes stress on the body that, in the long term, piles up," says Spector.



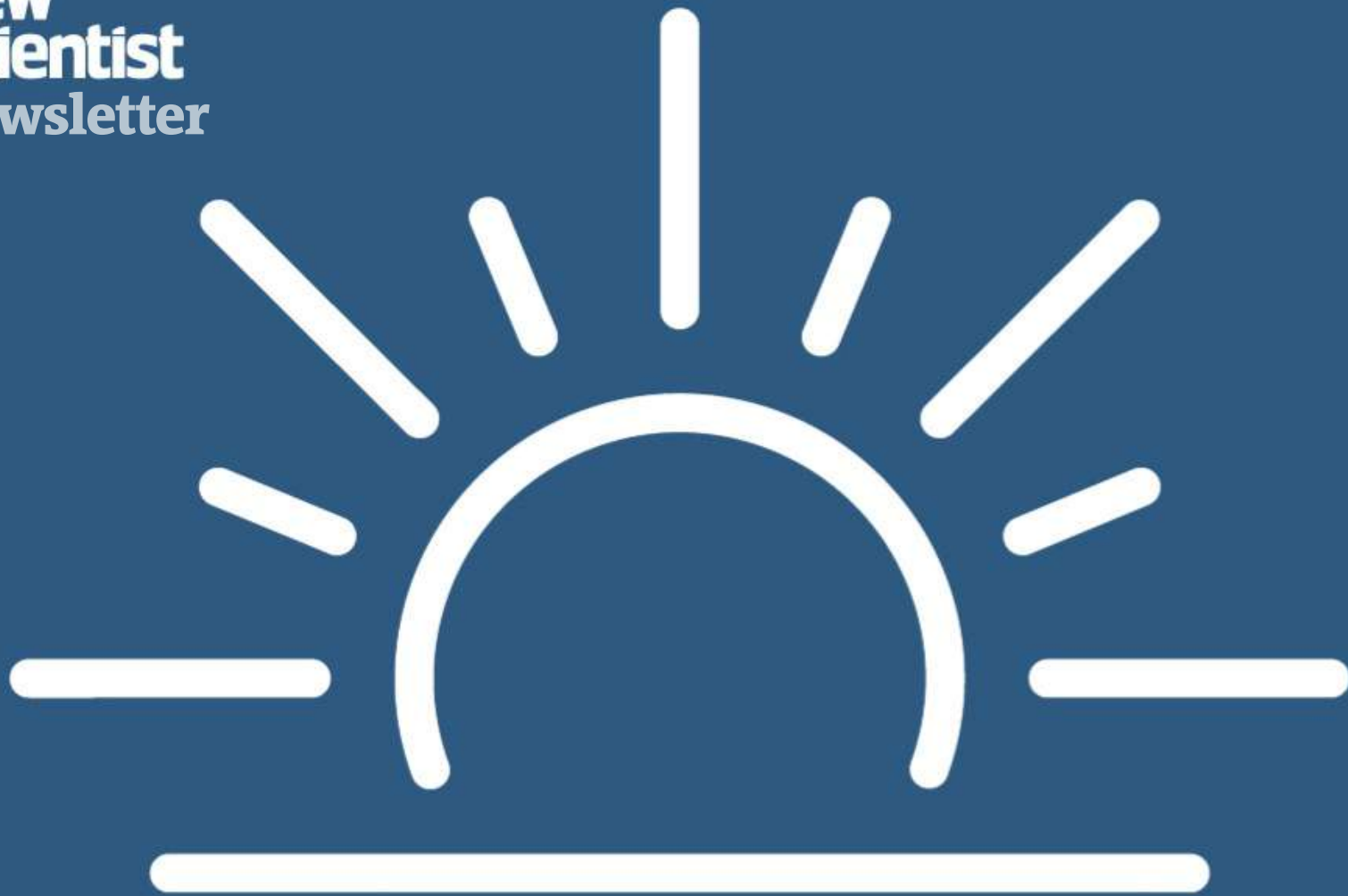
There are devices that help you monitor these surges in real time and understand which foods cause them (see "How to hack your meals", left). Blood glucose monitoring was previously the preserve of people with diabetes and, until 2014, would have involved a pinprick of blood. Continuous monitors are small, wearable devices that constantly read glucose levels in fluid between cells in the skin, which is a good proxy for blood glucose.

These personalised devices could make a big difference to health, even for those who think they are in good shape. One landmark study in 2018 used continuous glucose monitors on a group of 57 people and found that even those considered healthy experienced extreme spikes in glucose levels. In some people, just eating a bowl of cornflakes with milk triggered blood glucose spikes associated with prediabetes.

As we start to understand individual variability in our metabolism, it is likely that we will see many more devices come on the market. How they will ultimately affect our lives and health remains to be seen, but my experience with Lumen has at least left me making small shifts in my habits that could, in theory, drastically improve my metabolic health. I try to eat earlier in the evening and try to consume carbs only when I need them to fuel exercise. And it has certainly given me a renewed appreciation of the importance of sleep. Of course, no technology will make it any easier to keep up those changes – when it comes to resisting that morning croissant, the hard work is still on me. ■



Catherine de Lange is magazine editor at New Scientist



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One Health surveillance protects an interconnected world

The health of people, animals and the environment are closely linked; surveillance to monitor their health should be too.



Dr Sean Shadomy
Senior One Health Advisor, CDC One Health Office

Recent events have shown how the health of people, animals and our shared environment are closely connected. Most infectious diseases affecting people are zoonotic (they can be spread between animals and people), such as Covid-19, monkeypox, Ebola and avian influenza. These diseases can have profound impacts on societies. So how can authorities from different sectors find these diseases early enough to provide warning and control their spread? One Health – an approach that recognises that the health of people is closely connected to the health of animals and our shared environment – is the answer.

What is One Health surveillance?

Surveillance for zoonotic diseases cannot be effectively done by any single organisation or sector. Instead, the global community needs surveillance systems that bring together information from human, animal and environmental sources so that it can be rapidly analysed and provide a holistic, situational picture across all sectors.

A One Health approach is essential for detection, monitoring and response to zoonotic diseases and similar threats at the human-animal-environment interface, such as antimicrobial resistance. One Health surveillance is crucial for finding new, emerging zoonotic diseases, and it is important that every level of society is involved.



Surveillance is crucial for finding new, emerging zoonotic diseases and it is important that every level of society is involved.

Everyone has a role

The international organisations responsible for human and animal health, including the Food and Agriculture Organization of the United Nations (FAO), World Organisation for Animal Health (WOAH), and World Health Organization (WHO), play a critical role in using national data to monitor and warn about new disease threats.



One Health surveillance starts at the national level, where human and animal health events first occur and are then reported internationally. Countries can use the information collected by national One Health surveillance systems for early detection, response, and to provide guidance back to the community on disease prevention.

One Health surveillance systems developed by countries range from smartphone-based community surveillance to national platforms linking human and animal health surveillance systems. They can focus on a single disease or multiple diseases.

Building capacity is key

CDC and its partners provide One Health expertise to partners in countries and regions, including providing training and tools to strengthen surveillance and link the sectors together.

Each country is part of the global community, with shared responsibility for protecting the health security of that community. One Health surveillance and intersectoral coordination within and between nations will help to detect and prevent an epidemic of known infectious diseases as well as the next "disease X."

Why **cross-sector collaboration** is critical to public health

Overcoming emerging viruses is a global challenge that reaches beyond medicine.



Frank Duff
Senior Vice President of Virology Therapeutic Area, Gilead Sciences

SPREAD
WRITTEN BY
Mark Nicholls

While vaccines and antiviral treatments are important tools to address viral outbreaks, virology specialist Frank Duff believes it will take more to address the world's toughest healthcare challenges. Stigma and discrimination are common barriers to care for the communities most impacted.

Partnership is key

"We've seen it in our work with HIV and viral hepatitis and again during the Covid-19 pandemic. You can develop innovative medicines, but without strong partnerships and opportunities to reach out to communities that are poorly served or do not have access to healthcare information – the benefits of treatment can only be taken so far," says Duff, Senior Vice President of Virology Therapeutic Area, Gilead Sciences.

Duff argues that partnership is a key element in the process. "We work with government agencies, non-profit organisations, healthcare providers and community groups. We seek opportunities to understand medical needs and to help with dissemination of appropriate healthcare information so



More than medicine, in my view, Gilead acknowledges that healthcare solutions are multifactorial, and we are particularly aware of it in the challenges of moving toward greater health equity.

that people are informed. It is this type of collaboration that led to the development of Gilead's Covid-19 Community Outreach Webinars in the U.S., which served as a public service announcement aimed at overcoming vaccine hesitancy among communities with low rates of vaccination and high disease rates," he says.

Grant funding

Gilead also recently announced it will join a coalition of LGBTQ+ and human rights-focused organisations to mobilise and address the monkeypox public health emergency. As part of the collaboration, the company will provide up to \$5 million in global grant funding to immediately support public education and vaccine hesitancy communications, a public policy response and a global outbreak emergency fund for community organisations in regions with active monkeypox outbreaks.

"More than medicine, in my view, acknowledges that healthcare solutions are multifactorial, and we are particularly aware of it in the challenges of moving toward greater health equity," says Duff. "Global efforts must embrace cross-sector collaboration to help reduce and, ultimately, eliminate health disparities."

Advancing **global health equity** through inclusion

From endemics to pandemics, involving community voices directly in the research process can help drive more equitable care.



The world is experiencing a convergence of urgent viral threats, from the longer-standing HIV and hepatitis epidemics to the Covid-19 pandemic and the emerging monkeypox public health emergency. While scientific innovation has advanced the response to these challenges significantly, progress has not benefited all people and communities equally.

Person-centred care

Frank Duff, Senior Vice President of Virology Therapeutic Area, Gilead Sciences, notes that person-centred science is one critical way to drive more equitable care.

"At Gilead, person-centred science means ensuring our innovation is tailored to address the needs of those who may benefit from our medicines," explains Duff. "To achieve this, we must go beyond improving the diversity of

those enrolled in our clinical trials. We also need to bring community voices directly into the research process, from program planning to clinical trial execution."

Addressing the unmet needs

Several of Gilead's large-scale HIV global clinical research studies include a robust community engagement component, which aligns key stakeholders, including community partners. A dedicated advisory group comprised of HIV advocates and community leaders are responsible for counselling throughout the research process – from clinical trial design and recruitment strategies to looking at real-world and participant-reported outcomes.

Additionally, to inform its work in Covid-19 and future clinical trial design, they have established a council of people with a diverse

range of Covid-19 experiences to better understand their unmet needs and how the company could help address them.

Collaboration and integration

Engaging the community in the process not only leads to better science, but it also fosters greater trust and engagement throughout the trial and helps scientists better address the lived experiences of those they seek to serve.

"A common thread across our clinical research programmes is ensuring that patients, providers and others impacted by disease provide input," concludes Duff. "As we look to the future, we recognise the need to act with intention to ensure diversity and inclusion in clinical research so that when new treatments and innovations are introduced, they can help those who need them most."

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How today's virology leaders are **preparing for the future**

Investing in virology innovation and collaboration today will enable a rapid and effective response to the next global health threat.

Following Covid-19, virology expert Frank Duff warns that a future viral threat "will almost certainly arrive" and acknowledges that no single organisation, agency, or government can tackle this alone.

Key partnerships

Underlining the importance of collaboration and partnership to fight existing and future global health challenges, Frank Duff, Senior Vice President of Virology Therapeutic Area, Gilead Sciences, acknowledges there are unknowns in preparing for a future pandemic.



Another important part of the company's pandemic preparedness are partnerships the company has developed with academic institutions and other organisations that focus on the study of emerging viral pathogens.

"Through our internal research capabilities, we have accumulated a deep understanding of known viruses and virus families. Our scientists maintain a wide variety of platforms and approaches that can be rapidly accessed and tested on new pathogens as they emerge," he says.

Another important element of the company's pandemic preparedness are partnerships the company has developed with academic institutions and other organisations that study emerging viral pathogens.

These internal and external efforts ensure the company is well placed to respond to future viral threats.



This year, we expect to invest billions of dollars in research and development, including antiviral research and development, to ensure continued readiness and support for next-generation antiviral therapies.

Long expertise

Gilead has been at the forefront of innovation in HIV, hepatitis, and Covid-19 and has been a leader in virology for more than 35 years.

In HIV, they helped transform care by pioneering inventions that were once thought impossible, such as the first single tablet regimen to treat HIV.¹ The company continues to advance innovation in HIV with the pursuit of a long-acting HIV treatment and prevention option and the possibility of a cure for HIV. Gilead is also known for leadership in viral hepatitis, delivering treatments for Hepatitis C and B, and actively pursuing multiple pathways to a possible cure for chronic Hepatitis B.

The company applied its expertise to rapidly mobilise virology science and resources to support the global response to Covid-19. The company has also been active in the emerging monkeypox public health emergency.

Duff, who has a background in paediatric infectious disease, says: "Gilead's deep bench of expertise and the relationships we have allow us to be primed to take on future pandemics. This year, we expect to invest significantly in including antiviral research and development, to ensure continued readiness and support for next-generation antiviral therapies."

References

1. www.ema.europa.eu/en/medicines/human/EPAR/atrilpa. Last accessed September 2022 (include within article)



Find out more at
Gilead.co.uk

Antimicrobial resistance: the rise of a 'silent pandemic'

If the pandemic has taught us one thing, it is that we are not prepared to combat the serious threat that emerging infectious diseases can pose to human health and our economies.



Tiemo Wölken
Member of
the European
Parliament, S&D
Coordinator in
the Committee
on environment,
public health and
food safety, Vice
Chair of AMR
Interest Group

All deficiencies revealed with Covid-19 have long been recognised in the fight against antimicrobial resistance (AMR). I hope that the main lesson learned from the pandemic is that the time to act and be prepared to tackle AMR is now and not when it is too late.

According to an analysis published by the medical journal *The Lancet*, "In 2019, deaths caused by AMR were higher than HIV/AIDS or malaria, making this threat the leading cause of death worldwide." Moreover, the Board of the European Health Emergency Response Authority (HERA) recently listed AMR as one of its top three priority health threats in the European Union.

One Health approach

Tackling AMR has many facets and will need a global reinforcement of the One Health approach, meaning stepping up efforts in tackling the connections between human health, animal health and environmental protection.

Improved diagnostics

The overuse and misuse of antibiotics needs to stop. Our action in human medicines needs to be scaled up, offering alternative treatments and stewardships for healthcare professionals, including the appropriate use of antibiotics in university curricula. Monitoring and surveillance need to be strengthened as well as infection

prevention and control. A focus needs to also be put on better access to rapid and affordable diagnostic tools.

Enforcing strict measures

Prudent and responsible use of antibiotics in veterinary medicine should be promoted and general use considerably reduced. The use of antimicrobials and other pharmaceutical substances should not be allowed to compensate for poor animal husbandry practices.

Measures such as the introduction of continuous monitoring of AMR in the environment or greater transparency in antibiotic manufacturing throughout the entire supply chain are needed to mitigate the impact of pharmaceuticals in the environment. Companies have to be held accountable for the environmental release of pharmaceuticals from manufacturing plants and those operated by third parties at any stage of production.

Fighting the crisis together

Keeping antibiotics effective is everyone's responsibility. Therefore, we have to ensure that AMR is high not only on the EU policy agenda but on the global one. There is the need for urgent action through a cohesive and ambitious multi-sectoral One Health approach, which addresses human, animal and environmental health. The time to act is now and we have no time to waste. This fight can only be won when we act together – globally.

How to fix the broken funding model for new antibiotic discovery

Governments must pay for antibiotics with a subscription-for-access model offering developers appropriate reimbursement, regardless of how many drugs are used.



Aleks Engel
Partner Novo
Holdings and
Director, REPAIR
Impact Fund

WRITTEN BY
Tony Greenway

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Two things can tackle the antimicrobial resistance (AMR) crisis, notes Aleks Engel. "The first is better stewardship of antibiotic use," he says. "That might slow the spread of antimicrobial resistance genes.

Second, we have to develop new antibiotics; but to do so, it's vital we fix the funding model for new drug discovery because, right now, it's broken." Worryingly, it has been 38 years since the last new class of antibiotics was brought to market. The UN warned that, at this rate, 10 million people could die from drug-resistant infections by 2050.

Incentives for investors

Engel is a partner at Novo Holdings and director of the REPAIR Impact Fund which invests in early-stage development of therapies targeting resistant microorganisms. "I look at this from an investor perspective," he says. "Why are so few people investing in antimicrobials? And what needs to change to re-attract support for the development of the next generation of antibiotics?"

His first question is easily answered: developing antibiotics involves significant costs for an uncertain return. Some publicly traded companies developing antimicrobials have either lost significant value or gone out of business. Engel believes the solution is the introduction of a subscription-type payment model

linked to access, rather than volume of use. This would attract investors and guarantee developers appropriate reimbursement regardless of how much they sell.

Requiring a maintenance budget

Governments must think of antibiotic development like maintaining physical infrastructure. Hospital buildings erode over time and need new roofs and windows, which is why administrators have a budget for repairs. "It's the same with antibiotics," explains Engel. "They're eroding because of AMR. As a consequence, they require a set budget."

Economic solution to the AMR crisis

The UK is a pioneer of this new subscription-style mechanism: in April, the NHS began paying two pharma companies a fixed fee for access to their antibiotics. "It seems to be working nicely," says Engel. "It costs around £20 million a year which is an absolute bargain because of the value it derives. Sweden is doing something similar. Now, we need all the other countries in the G20 to follow suit, which is why we're currently making the case for a subscription model to finance ministers. It's not like some of the other intractable problems the world faces. With this one, we know what the solution is, and we know it works. So why aren't more countries doing it?"



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Puzzles

Try our crossword, quick quiz and logic puzzle **p53**

Almost the last word

When moving at light speed, will a torch still shine ahead? **p54**

Tom Gauld for *New Scientist*

A cartoonist's take on the world **p55**

Feedback

Pop-up theatre seats and spicy water: the week in weird **p56**

Twisteddoodles for *New Scientist*

Picturing the lighter side of life **p56**

Stargazing at home

Time for a shower

A triptych of meteor showers will pepper the sky in October: the Draconids, the Orionids and the Taurids, says **Abigail Beall**



Abigail Beall is a features editor at *New Scientist* and author of *The Art of Urban Astronomy* @abbybeall

What you need A clear night

ONE evening in August, my partner and I set off after work for a weekend away to celebrate our friends' wedding. We had expected the journey to take about 3 hours, but we got caught in a traffic jam that turned it into 6.

I sat in the passenger seat, getting increasingly frustrated as the cars and fields around me changed very little and the estimated arrival time on my phone crept later and later. We had expected to get there in daylight, but while the sun set, I looked out. As the glints of Saturn, Vega and Arcturus appeared, I noticed a bright flash move across the sky. I craned out of the window and saw a few more: it was my first ever in-car meteor shower. I only saw four of the Perseid meteors that evening, but it certainly brightened up the traffic jam.

In the northern hemisphere, this time of year can feel bleak as the nights draw in. But the saving grace of earlier sunsets is that you don't have to be such a night owl to catch some meteors. In fact, in October alone, there are three meteor showers to look out for. They will be visible from all over the world, but you will have to stay up later to see them in the southern hemisphere, where the days are getting longer.

First up is the Draconid meteor shower, which peaks on 8 and 9 October. As with any meteor shower, you don't need to pinpoint its source to see it, but this one radiates from Draco. Find the summer triangle of stars, draw a line from Altair to Vega, then



keep on going and you will soon reach Draco. Just like other meteor showers, the streaks of light can cross the sky in any direction.

The Draconids will be followed by the Orionids, which peak on 21 October. To find this shower's centre, start with the three stars that make up Orion's belt. Then try to locate Betelgeuse, the bright, yellowy star that represents Orion's left shoulder when viewed from the northern hemisphere. The Orionid meteors should begin from around this point in the sky.

All meteor showers are caused by Earth moving through debris left over from a comet or asteroid, and the Orionids are caused by debris from Halley's comet, which was last visible from Earth in 1986 and will be again in 2061.

If you miss the Orionids, don't

worry: the Taurids will follow shortly afterwards. They come in two displays, neither of which has a strong peak, kicking off from mid-October and with most of their activity in the first two weeks of November. These will radiate from Taurus, another constellation that is visible around the world.

It is worth timing your meteor gazing for around the new moon of 25 October, when the most meteors are likely to be visible. Pick a clear night, try to find a spot away from light pollution and let your eyes adjust to the dark so you can enjoy the spectacle. I wouldn't, however, recommend watching from a traffic jam. ■

Stargazing at home
appears every four weeks

Next week

Science of gardening

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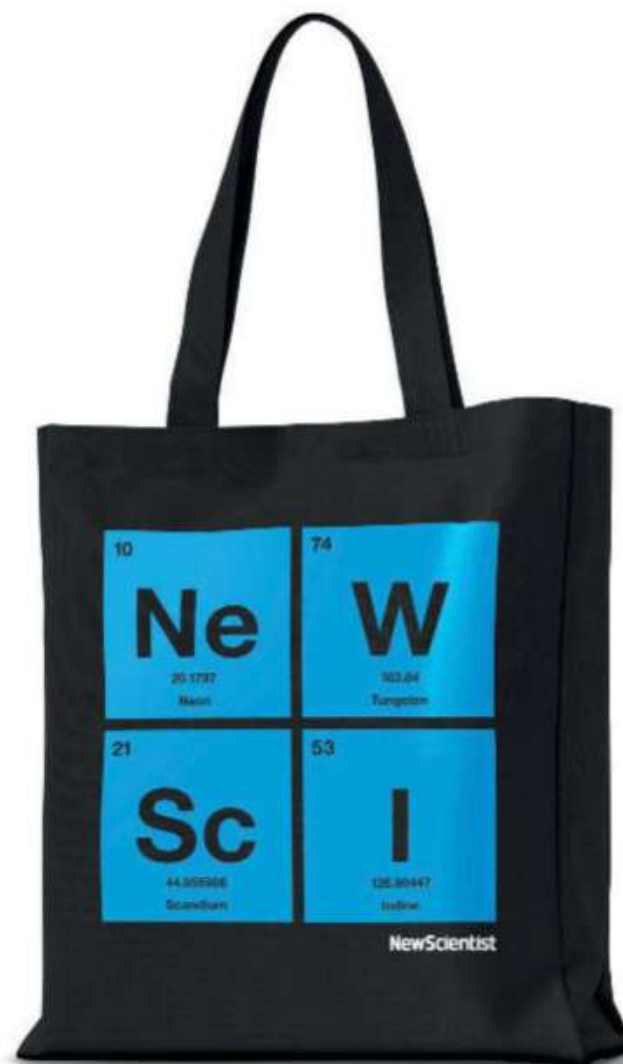
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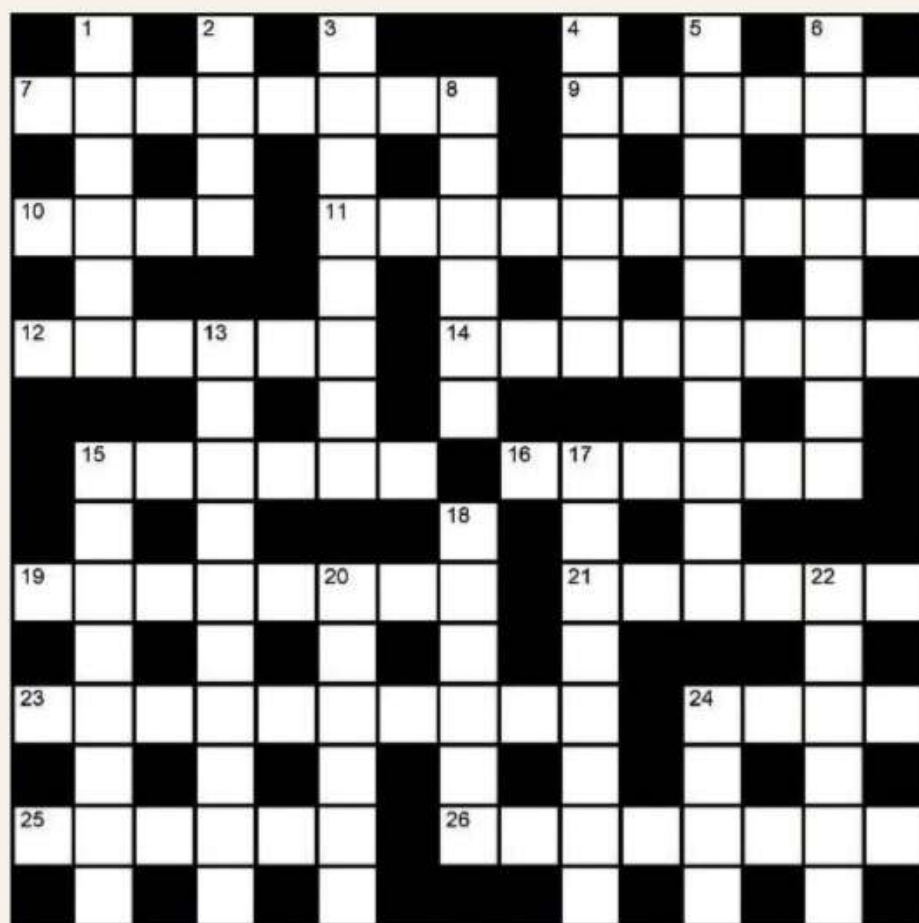
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Quick crossword #118 Set by Richard Smyth



Scribble zone

Answers and the next cryptic crossword next week

ACROSS

- 7** Concept in chess and combinatorial game theory (8)
9 Os (6)
10 Type of exoatmospheric ballistic missile (4)
11 Kingfisher of Australia (10)
12 Receptacle in which a spider's offspring may hatch (3,3)
14 Sweet-smelling gum resin also called bisabol or scented myrrh (8)
15 Hollow for an eye or tooth, perhaps (6)
16 Highest point in the celestial sphere (6)
19 Blue corundum (8)
21 Number of degrees in a right angle (6)
23 1998 comet drama (4,6)
24 Outer skin of a tree (4)
25 Dove (6)
26 Sudden prevalence of an acute disease (8)

DOWN

- 1** Alan ____, computing pioneer (6)
2 Sea of ____, the world's shallowest sea (4)
3 Pain in the thoracic or lumbar region, perhaps (8)
4 Starchy tuber, *Solanum tuberosum* (6)
5 Removal of a limb (10)
6 Charlotte ____, German geneticist (8)
8 10^{100} (6)
13 Disguised online identity (4,6)
15 Quackery (5,3)
17 Albert ____, German-born patent examiner (8)
18 Organic compound, C_6H_{14} (6)
20 Resistant to infection (6)
22 Cloudy; muddled (6)
24 Electronic noise (4)

Quick quiz #172

- Which of these volcanoes isn't on Mars: Mons Rümker, Apollinaris Mons or Hecates Tholus?
- Exocrine glands in which a portion of secreting cells is lost during secretion are known as what?
- Which birds form the order Podicipediformes?
- Riboflavin is better known by what name?
- In what year did Thomas Edison invent the phonograph (later known as a gramophone)?

Answers on page 55

Puzzle

set by Colin Beveridge
#188 Four forgetful footballers

"I guess we had a football tournament yesterday!" said Clara, the Cleverton goalkeeper, noticing the trophy for the Friendly International Tournament for the Brainy but Absent-Minded on the table.

"I wish I could remember," said Sima, the Smarta Prague centre-back. "I presume it was the usual 3-points-for-a-win affair with ties settled using goal difference."

Astutegart's star striker, Astrid, agreed. "I remember..." (she stopped to count) "...four teams all played each other! And in each game, there were exactly three goals."

"I remember that we all scored a different total number of goals," said Inge, Interlecht's winger. "And each team scored a different number of goals in each of our games."

"I remember," said Clara, "that we let in more goals than anyone else." "I scored three goals against you, Clara," said Sima.

"And Inge scored three against us," said Astrid. Inge thought for a moment. "Then I can work out who won the tournament!"

Who did win?

Solution next week



Our crosswords are now solvable online
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Speedy light

I am at the rear wall of my spaceship travelling at the speed of light. I switch on my flashlight. Will the light reach the front wall?

Herman D'Hondt

Sydney, Australia

The quick answer to this question is simple: the scenario is impossible. Only massless objects can travel at the speed of light (c). A spacecraft obviously has mass, and hence can never travel at c . Let's assume that you aren't going quite that fast, say only $0.99999c$. Albert Einstein's theory of relativity assures us that light always travels at c , no matter how we measure it. Hence, the photons will reach the front wall, having traversed the distance at speed c .

Mark Dirnhuber

Bristol, UK

This question is central to Einstein's special theory of relativity and the answer is shocking. Strictly, physics determines that no material object can move at the full speed of light (c) relative to an observer, but it can move as near to c as we like without actually reaching it. So the following arguments only hold below that limit.

Even if the spaceship is moving at a mere fraction less than c , not only will the light from the flashlight move at the full c , as measured by you, the observer, inside the spaceship, but also light coming from a star from which the ship is receding will appear to rush past you at that same full speed (albeit with a longer wavelength in your view: this is the famous "redshift").

Imagine you are in your spacecraft, travelling at constant speed in a straight line, and that you are unable to look outside. How can you tell you are moving? No experiment could possibly answer this.

The speed of light is constant relative to any observer, irrespective of how fast they are moving relative to its source.



ROGER HOOPER LLECHRYD

This week's new questions

Drain dangles What are these soft, white balls, about 5 centimetres long, found under a drain cover (pictured)?

Roger Hooper, Llechryd, Ceredigion, UK

Red alert Why are many people squeamish about the sight of blood when, for much of history, we had to butcher animals?

Derek Johnson, Moreton-in-Marsh, Gloucestershire, UK

This is the result of the Michelson-Morley experiment in 1887. There can be no absolute stationary frame of reference: all movement at constant velocity is only relative to some other (equally arbitrary) frame. As a corollary, there can also be no absolute time.

These ideas defy common sense, yet the evidence for their veracity is overwhelming. We just have to accept that this is shocking, that common sense fails in this case, and move on in our spaceship.

Steve Hoskins

Reading, Berkshire, UK

If you do get a spaceship made of matter to travel at the speed of light, could you let us know what happens, as relativity can't tell us.

Please also let us know how you managed it, as relativity says it requires an infinite amount of energy to do so.

@fizzix2020

via Twitter

Your premise is physically impossible. Unless you and your spaceship are massless, travelling at the speed of light violates the laws of physics.

@FullcntctFighter

via Twitter

If you are travelling at that speed, you are a photon. No lamps, no walls. Sorry.

@MarkAlexanders

via Twitter

Time would no longer exist for you to flick the switch.

What are these soft, white balls found clinging to the bottom of a drain cover?

Ralph Winrich

Dunkirk, Wisconsin, US

The question of turning on a flashlight at one end of a spacecraft while travelling at the speed of light is intriguing on several levels. If you are moving at the speed of light, I wonder what you and your ship would be made of, as, at that speed, your mass would be equal to that of the rest of the universe perhaps.

At any rate, the beam of light emitted by your flashlight would appear to reach the far wall instantly, as the speed of light is independent of your speed and would always be constant at about 300,000 kilometres per second in a vacuum.

Steve Hyams

Manchester, UK

In my Marvel comics, Superman travelled at the speed of light against the rotation of Earth and time went backwards. So, don't spoil my childhood please. Or maybe I could use this to go back to my childhood. I'll leave next Tuesday, so if someone can lend me a torch, I'll try the experiment. If I get back, which itself is no small question, I'll let *New Scientist* know the answer.

By a hair

At the recent Commonwealth Games, I was struck by how many runners with long hair had tied it in a ponytail. When fractions of a second can decide a race, surely looser hair is a drag?

Stephen Johnson

Eugene, Oregon, US

How much does long hair increase wind resistance or drag in running competitions? All components of the human body contribute to the drag produced when a runner tries to move through a fluid, in this case air.

Air has inertia and to make it

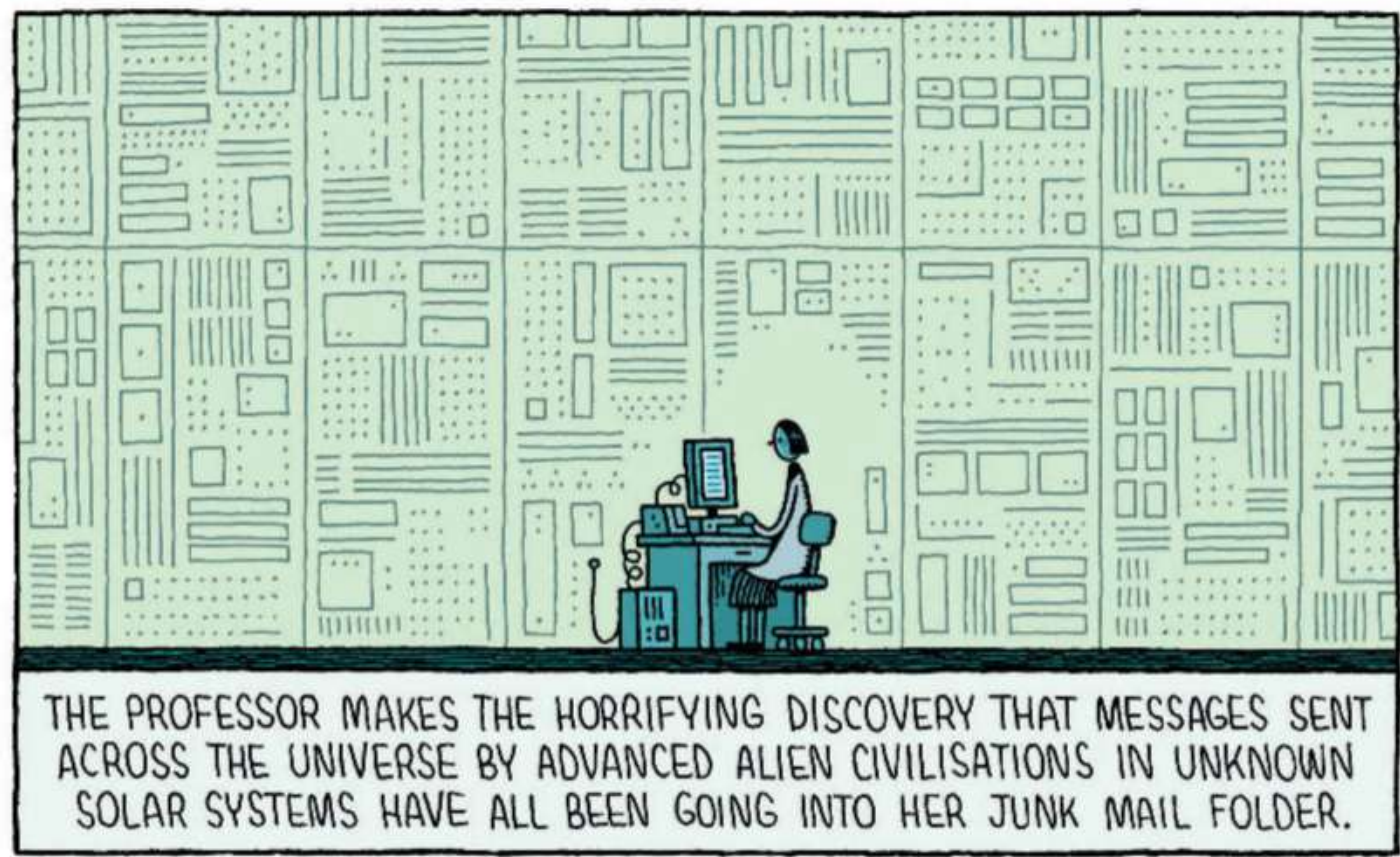


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move out of the way, you have to transfer energy from the runner to the air. As to how much extra energy the long hair demands, there was considerable analysis of this after Greg LeMond beat Laurent Fignon in the final stage of the Tour de France cycle race in 1989. For this, LeMond rode a more aerodynamic bike and wore an aerodynamic helmet, while Fignon used a standard bike and let his ponytail trail in the wind. Calculations showed that the ponytail added slightly more than 8 seconds to Fignon's time and that without it, he would have won. Drag forces are proportional to the square of velocity. The speed of cycling is faster than running and in the case of LeMond, he averaged 2.8 times the speed of the recent world record for women's 400 metre hurdles. This would mean that the drag was almost eight times higher than in such running. So, if Fignon lost 8 seconds because of the ponytail, a hurdler would have only lost about 1 second over the same distance of 24.5 kilometres.

“Calculations show the ponytail added more than 8 seconds to the cyclist's time. Without it, he would have won the Tour de France”

Scale this to a 400-metre race and the loss would be 0.0163 seconds. Is this enough to lose a race? Especially as other differences in body shape and technique probably have a much bigger effect. A swim cap would solve the ponytail issue, and athletics has experimented with full body running suits with hoods. In swimming, the resistance of water is 784 times that of air and no serious competitor would swim with an uncovered ponytail.

Simon Dales
Oxford, UK

The power required to overcome drag increases in proportion to the cube of the speed. This means that runners go too slowly to be much troubled by drag due to their

aerodynamics. Cyclists habitually go faster, so have to be much more careful with their hair. Wind-tunnel experiments show that, at racing speeds, a cyclist can lose 10 to 20 watts of power with a flapping ponytail. The turbulence behind their heads and shoulders grabs the hair and swirls it around. This is a big loss. So, for cyclists, it is best to either cut their hair short so that it gets hidden by their aero-hat or have a single, tight plait. On the other hand, cyclist Peter Sagan's hair is famously bouffant and he wins sprints/stages, but I suspect that his helmet holds his mop in tight. Runners are largely upright and don't present a particularly aerodynamic shape anyway, so the drag from hairstyle is probably insignificant for them.

Ron Whelan
via Facebook

My running days are over, but perhaps, like me, the reason for tying hair back is simply to keep it out of your face and nothing to do with speed or resistance. ■

Answers

Quick quiz #172
Answers

- 1 Mons Rümker – it is on the moon
- 2 Apocrine glands
- 3 Grebes
- 4 Vitamin B2
- 5 1877

Cryptic crossword
#93 Answers

- ACROSS** 1 Bleached, 5 Mewl, 8 Adequate, 9 Talc, 11 Get at, 12 Tangelo, 13 Fjords, 14 Inhale, 17 Caraway, 19 Oared, 21 Lode, 22 Marmoset, 23 Yank, 24 Pendulum
- DOWN** 1 Bragg, 2 Electro, 3 County Down, 4 Estate, 6 Enate, 7 Lactose, 10 Uninformed, 13 Faculty, 15 Aerosol, 16 Aye-aye, 18 Radon, 20 Datum

#187 Key decision
Solution

The casket containing the car keys is number 3.

The rows in the table below show whether each of the clues 1-4 is true or false for each casket, if we assume the keys are in that casket.

If the keys are in casket	Clue True or False			
	1	2	3	4
1	F	T	T	F
2	T	F	T	F
3	F	T	F	F
4	T	F	T	T

It can be seen that only if the keys are in casket 3 are three out of the four clues false.

Pop-up theatre

For some of those returning to theatres and concert halls, the risk of covid-19 infection is just an extra hazard to grapple with on top of that well-known auditorium danger: getting jostled by other spectators.

A study called “Technological Change and Managerial Challenges in the Movie Theater Industry”, published in the *Journal of Cultural Economics*, discusses how to attract new audiences by offering boxes, VIP seats and lots and lots of new technology. But that analysis, like many before it, ignores one Louis J. Duprey’s incredible trapdoor/pop-up seating innovation.

Duprey invented a system that “permits any patron of the theatre to enter or leave his place without at all disturbing other patrons”. His US patent, number 1517774, granted way back in 1924 and modestly titled “Theater Seating Equipment”, presents details in words and inspirational drawings.

All theatregoers, upon arriving, stroll into a lobby under the theatre proper. It is filled with special chairs, each mounted on a long tube-within-a-tube sunk into the floor. (The chair is, in this way, rather like a hand stuck on the end of an arm that is encased in a shirtsleeve.) One sits down and turns a knob attached to the seat. The hydraulically powered cylinder-in-a-cylinder apparatus lifts one straight up and through a trap door above. This leads to the auditorium. The trap door closes, becoming the floor.

Not content with just saving us from restive fellows in the stalls, Duprey envisioned a safety benefit. The system provides “means whereby all of the seats of the auditorium may be simultaneously lowered in case of fire or other panic to an exit sub-chamber that is preferably of completely fireproof construction”. That said, his idea never really got off the ground.

How close is too close?

How perfectly circular is personal space? Very, suggests a study called “The Shape of Personal Space”, in

Twisteddoodles for New Scientist



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the journal *Acta Psychologica*.

The notion of personal space is a bit nebulous, and the study acknowledges that it is hard to get people to agree to a definition. Regardless, the researchers suspected that an individual’s personal space has a definite shape, and that it is a self-centred horizontal circle. They tried to measure the soundness of the roundness of that circle.

The study involved various encounters between live humans, virtual human avatars and a “life-size, gender-neutral mannequin” with “a bald Styrofoam head with glass eyes”. The dummy, according to the report, was mounted on a height-adjustable, wheeled tripod and wore a grey coat.

The researchers conclude that, with the exception of “very minor idiosyncrasies”, personal space is indeed circular. The most major

minor idiosyncrasy, they specify, is evident when a person is confronted simultaneously with two virtual avatars, one approaching from the left and the other passively standing off to the right. Persons tended to feel “comfortable” letting the approaching avatar get extra close.

What is the preferred radius of the personal-space circle? That depends. But one can gather numbers, even if you don’t get into the why of them. The researchers say their numbers accord nicely with those they had seen in a study called “Preferred Interpersonal Distances: A global comparison”, which was published in the *Journal of Cross-Cultural Psychology*. That project asked people in 42 countries to indicate, using paper-and-pencil versions of two human silhouettes, how close is too close.

People in different countries had different keep-your-distances. Argentinians, on average, were the happiest to be closely approached. They welcomed strangers to get a mere 65 centimetres from them – well within touching distance. Those in some other countries – Romania, Hungary, Saudi Arabia and Turkey – preferred much more space, indicating strangers ought to stay at least twice that far away.

Hold the chillis

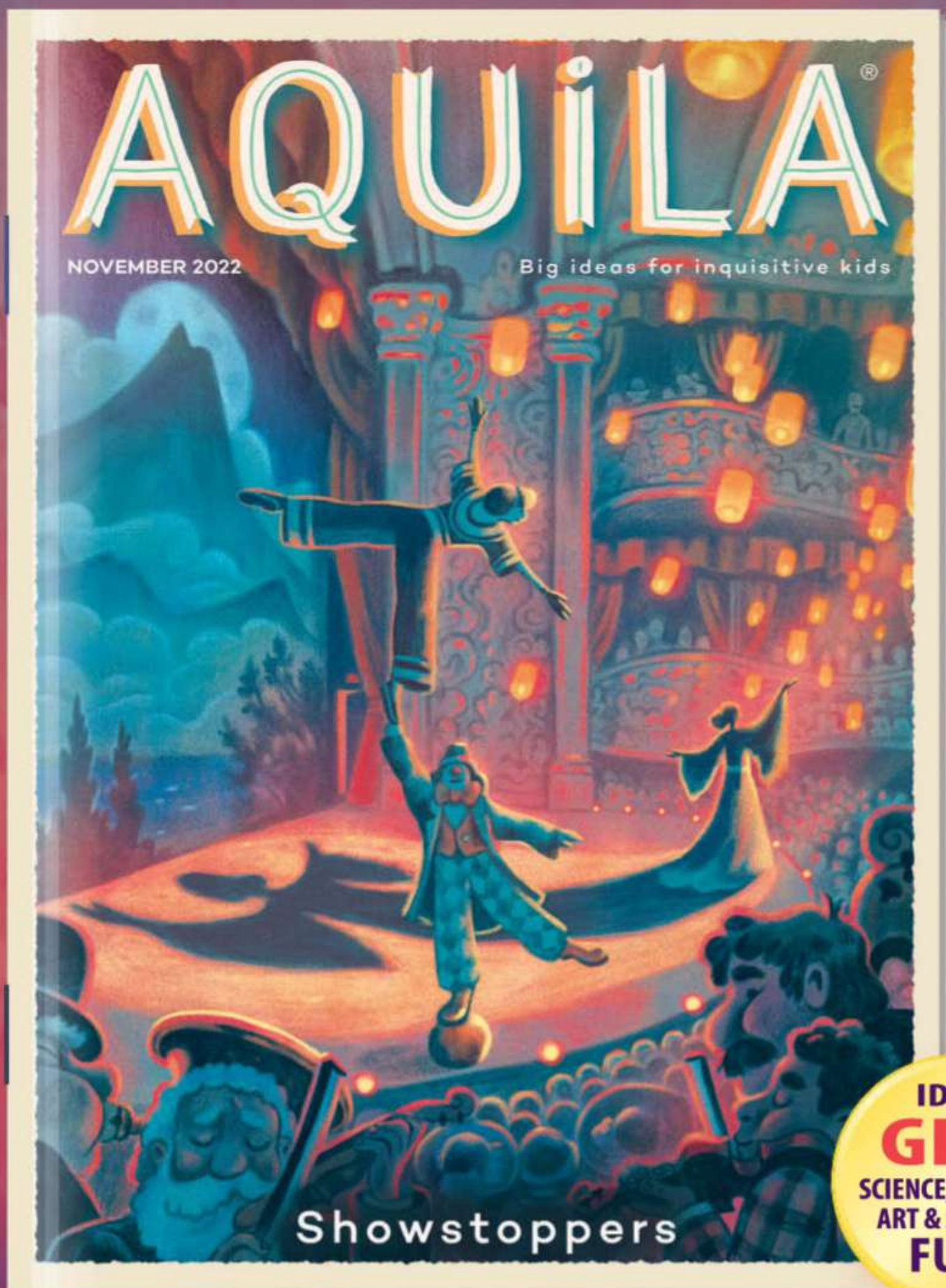
A new study called “The Intrusion of Spicy Water Favors the Intensification of Arabian Sea Cyclones” caught the attention of Tom Gill. Gill, who is an Earth scientist at the University of Texas at El Paso, told Feedback: “I have no idea what spicy water is.”

However, some oceanographers do have an idea. Two decades ago, Pierre Flament wrote a now much-cited paper defining water spiciness. This he published in the journal *Progress in Oceanography*. It is nine pages long. An imprecise definition might say: water that is warm and salty is “spicy”.

Oceanographers speak also of “minty” water. Compared to spicy water, minty water is cool (lower in temperature) and fresher (less saline). Gualtiero Spiro Jaeger’s recent short treatise, “‘Spicy’ & ‘Minty’ Water”, in the journal *Oceanus*, tells how the two oceanography concepts are used to analyse mixing. Specifically, that which does or doesn’t happen when two big blobs of water with contrasting qualities meet.

These culinary words can express somewhat different meanings when deployed by, say, advertisers of salsa and mouthwash. Or by chemists, as one sees in Doris R. Kimbrough’s 1997 paper in the *Journal of Chemical Education*. Called “Hot and Spicy versus Cool and Minty as an Example of Organic Structure-Activity Relationships”, it sings the earthy mealtime merits of chemicals that are spicy (capsaicin, piperine and zingerone) or cool (menthol and carvone). Water gets barely a mention. ■ Marc Abrahams

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